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AFWL-TR-69-114, Vol II

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USER'S MANUAL

Volume II

Volume II Boundary Layer Integral Matrix Procedure (BLIMP)

Larry W. Anderson

Robert M. Kendall

TECHNICAL REPORT NO. AFWL-TR-69-114, Vol II

March 1970

AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base
New Mexico

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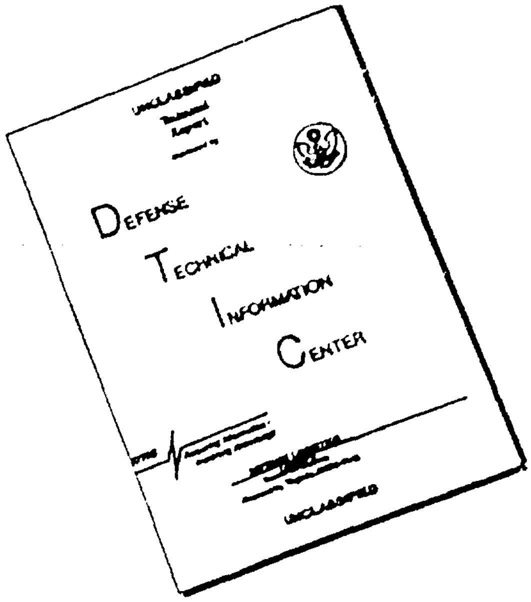

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Air Force Systems Command
Kirtland Air Force Base
New Mexico

FOREWORD

This report was prepared by the Aerotherm Corporation, Mountain View, California, under Contract F29601-68-C-0062. The research was performed under Program Element 62601F, Project 5791, Task 27.

Inclusive dates of research were March 1968 through October 1969. The report was submitted 11 February 1970 by the Air Force Weapons Laboratory Project Officer, Captain Ronald H. Aungier (WLEE).

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This technical report has been reviewed and is approved.

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ABSTRACT

Listings and flow charts for the Boundary Layer Integral Matrix Procedure (BLIMP) computer program are given, along with comments on the function of each program or subroutine. In addition, input instructions, output description, a sample problem, flow charts and listings are given for the CABLE program, which couples BLIMP to an in-depth charring ablation analysis program.

(Distribution Limitation Statement No. 2)

CONTENTS

SECTION I

INTRODUCTION

This report (AFWL-TR-69-114, Vol. II) contains flow charts and listings for the BLIMP and CABLE computer programs, and also input instructions, output descriptions, and a sample problem for the CABLE program. The BLIMP program solves the laminar or turbulent, nonsimilar multicomponent, equilibrium boundary layer for axisymmetric or planar bodies and for general chemical systems. The theoretical development and computational procedures which form the basis for this computer program are discussed in reference 1. The bulk of the user's manual material (input, output, operating instructions, dimensions, etc.) for the BLIMP program is contained in Volume I of this report.

The CABLE program is a coupled boundary layer and in-depth material response calculational tool which uses the BLIMP code in combination with the CMA (reference 2) program to analyze the complete thermodynamic response of ablating bodies. A discussion of the coupling of the two basic computer codes is given in reference 1 as is a sample problem. The CMA program is completely documented in references 2-5, and will be only briefly discussed here.

Section II of this volume is devoted to flow charts and listings for the BLIMP code. Section III contains descriptions of the CABLE input, output, preparation of a sample problem, and flow charts.

SECTION II

BLIMP LISTINGS AND FLOW CHARTS

The BLIMP subroutines are all numbered and are presented in this section in numerical order. The numbers reflect the approximate order in which the routines are called.

1. PROGRAM BLIMP - BO2A

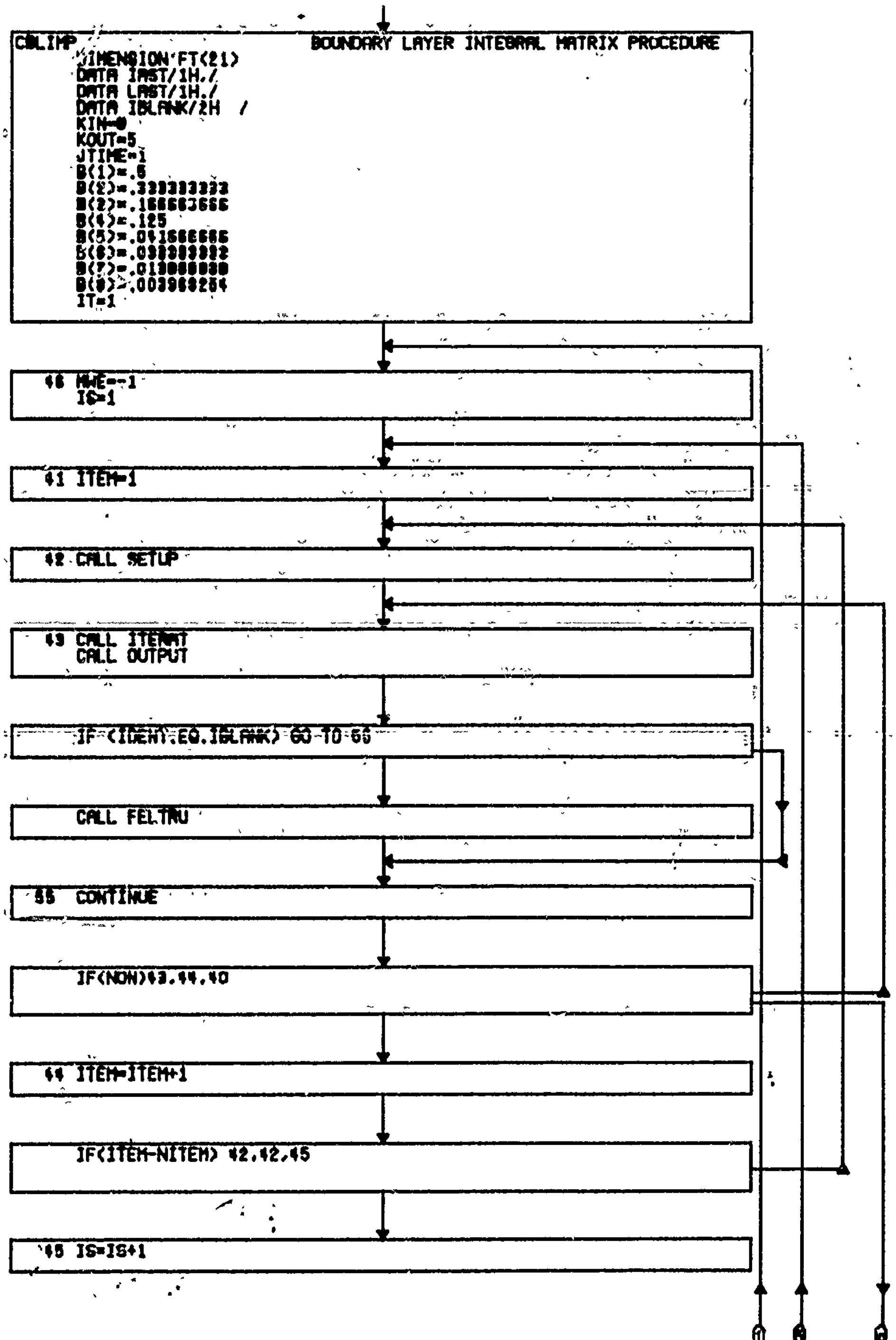
   a. Function

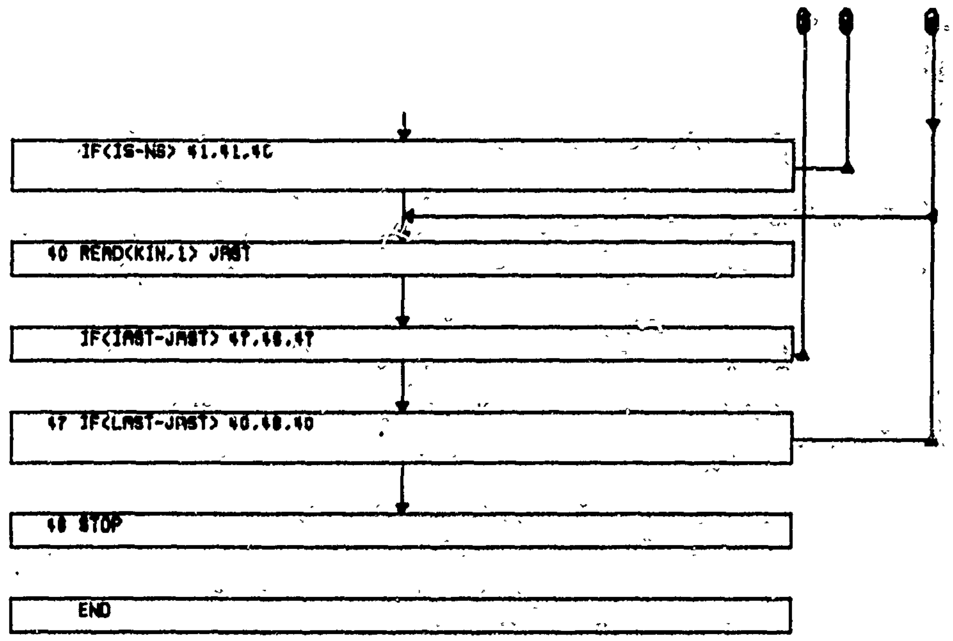
      Master Program. Calls SETUP, ITERAT, OUTPUT.

b. Listing

```
           CBLIMP                        BOUNDARY LAYER INTEGRAL MATRIX PROCEDURE   BLIM 001
                 DIMENSION FT(21)
                 COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB02A   3*NEW
                1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CRAR,CASE(15) B02A   4*NEW
                2,B(8),        MWE,NON,K9(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B02A  5*NEW
                3,KAUXC,JTIME,JSPEC,MD(3)                                          B02A   6*NEW
                 COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         B02A   7*NEW
                1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      B02A   8*NEW
               1 FORMAT(A1)                                                               *-11
                 DATA IAST/1H,/
                 DATA LAST/1H,/
                 DATA IBLANK/2H  /
                 CALL SETIO(8,1)
                 CALL SETIO(5,2)
                 CALL SETDR(13,1100000,500000,FT(8))
                 CALL SETDR(14,600000,500000,FT(15))
                 KIN=5                                                             BLIM 013
                 KOUT=6                                                            BLIM 014
                 JTIME=1
                 B(1)=.5                                                           BLIM 015
                 B(2)=.333333333                                                   BLIM 016
                 B(3)=.166666666                                                   BLIM 017
                 B(4)=.125                                                         BLIM 018
                 B(5)=.041666666                                                   BLIM 019
                 B(6)=.033333333                                                   BLIM 020
                 B(7)=.013888888                                                   BLIM 021
                 B(8)=.003968254                                                   BLIM 022
                 IT=1                                                              BLIM 023
              46 MWE=-1
                 IS=1                                                              BLIM 025
              41 ITEM=1                                                            BLIM 026
              42 CALL SETUP                                                        BLIM 027
              43 CALL ITERAT                                                       BLIM 031
                 CALL OUTPUT                                                       BLIM 032
                 IF (IDENT.EQ.IBLANK) GO TO 55
                 CALL FELTRU
              55 CONTINUE
                 IF(NON)43,44,40                                                   BLIM 033
              44 ITEM=ITEM+1                                                       BLIM 034
                 IF(ITEM-NITEM) 42,42,45                                           BLIM 035
              45 IS=IS+1                                                           BLIM 036
                 IF(IS-NS) 41,41,40                                                BLIM 037
              40 READ(KIN,1) JAST
                 IF(IAST-JAST) 47,46,47
              47 IF(LAST-JAST) 40,48,40
              48 STOP
                 END                                                               BLIM 038
```

c. Flow Chart


CBLIMP
BOUNDARY LAYER INTEGRAL MATRIX PROCEDURE
DIMENSION FT(21)
DATA IAST/1H./
DATA LAST/1H./
DATA IBLANK/2H /
KIN=0
KOUT=5
JTIME=1
B(1)=.5
B(2)=.333333333
B(2)=.166663666
B(4)=.125
B(5)=.041666666
B(6)=.033333332
B(7)=.013888880
B(8)=.003968254
IT=1
40 MWE=-1
IS=1
41 ITEM=1
42 CALL SETUP
43 CALL ITERAT
CALL OUTPUT
IF (IDEN).EQ.IBLANK) GO TO 55
CALL FELTRU
55 CONTINUE
IF(NON)43,44,40
44 ITEM=ITEM+1
IF(ITEM-NITEM) 42,42,45
45 IS=IS+1


IF(IS-NS) 41,41,40
40 READ(KIN,1) JAST
IF(IAST-JAST) 47,48,47
47 IF(LAST-JAST) 40,48,40
48 STOP
END

2. SUBROUTINE SETUP - B03A

a. Function

Control program for setting up boundary layer edge conditions and streamwise derivatives for a new time (or subcase), a new station, or a new case. Called by BLIMP. Calls FIRSTG, LINMAT, RECASE.

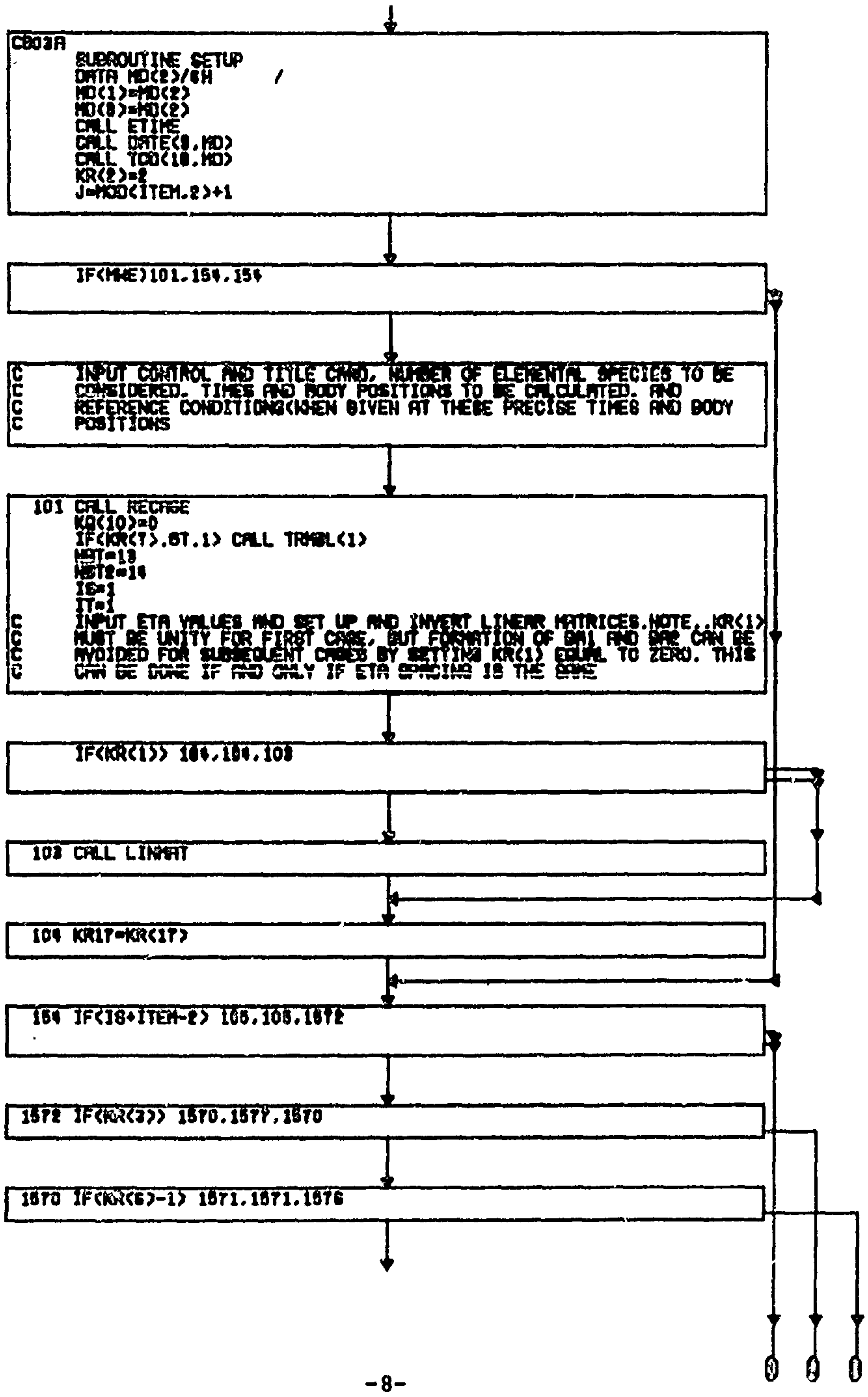
b. Listing

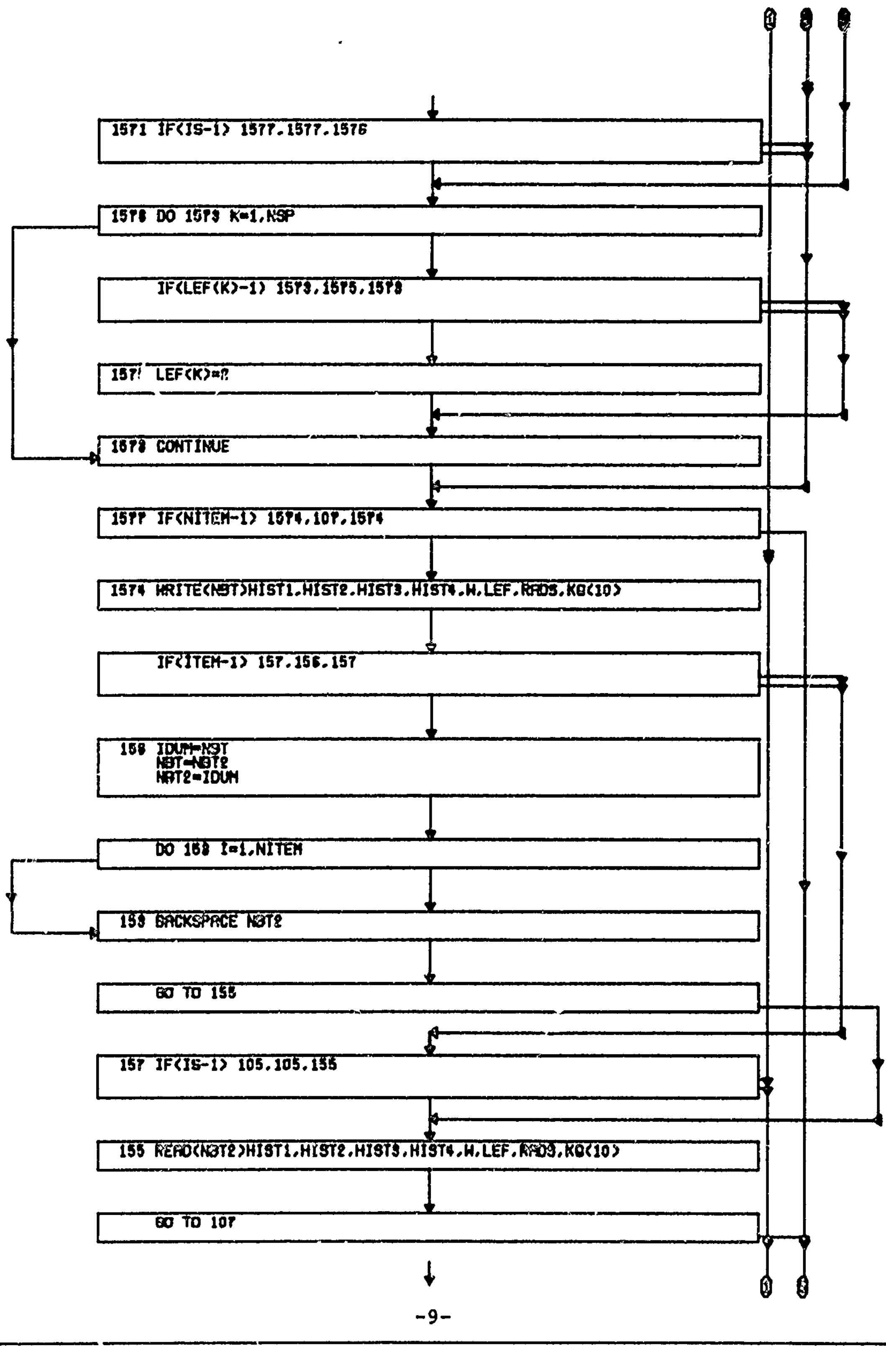
```
CB03A
      SUBROUTINE SETUP
      DIMENSION HIST1(605),HIST2(607),HIST3(511),VMAT(566),HIST4(600)
      COMMON/BLQCOM/  MOA( 71),  MOB( 71),NSPEC,FR( 71,15),W(3),LEF(10)
     1,LEFS(10),PIEASE,LEFW(10)
      COMMON/EDGCOM/             PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,
     1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90
     2 ,DSIP(40),IDSIP,TTVC,TVCC(40)
      COMMON/FLPCOM/TXI(2),TUE(2),TRHOE(2),TTE(2),TVMUE(2),TMAT(566,2)
     2,THF(15,2),LEFT(10,2),TPE(2),TRADS(2),TDSIP(2),KQT(2)
      COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14,
     1 ),XI(40),HF(15,5),HG(15,3),HSP(19,3, 8),HALPH,HUE,HHUE,HFW,DLX2
     2,C3M(40),BETAM(40)
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,N
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15)
     2,B(8),       MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40)
     3,KAUXO,JTIME,JSPEC,MD(3)
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 30),GE( 50),S(40),ROKAP(40)
     1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,
     2CONE,RADFL( 50),RADR(40),RADS(40),IRAD
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ
      EQUIVALENCE(HIST1,XI),(HIST2, PE),(HIST3,F),(VMAT,C1),(HIST4,FW)
    2 FORMAT(1H18X4HTIMEE12.5,56H SECONDS - - - - - - - - - - - - - - -
     1- - - - - - - - -,2X3A6)
    3 FORMAT(/1H17X4HTIMEE12.5,35H SECONDS - - - STREAMWISE DIMENSIONE12
     1.5,11HFEET - - -,2X3A6)
    4 FORMAT(1H18X4HCASEI3,32(2H -)2X3A6)
    5 FORMAT(1H17X4HCASEI3,11(2H -)21H STREAMWISE DIMENSIONE12.5,13H FEE
     1T - - - -3A6)
 9901 FORMAT(I3,7E10.3)
      DATA MD(2)/6H      /
      MD(1)=MD(2)
      MD(3)=MD(2)
      CALL ETIME
      CALL DATE(9,MD)
      CALL TOD(18,MD)
      KR(2)=2
      J=MOD(ITEM,2)+1
      IF(MWE)101,154,154
C     INPUT CONTROL AND TITLE CARD, NUMBER OF ELEMENTAL SPECIES TO BE
C     CONSIDERED, TIMES AND BODY POSITIONS TO BE CALCULATED, AND
C     REFERENCE CONDITIONS(WHEN GIVEN AT THESE PRECISE TIMES AND BODY
C     POSITIONS
  101 CALL RECASE
      KQ(10)=0
      IF(KR(7).GT.1) CALL TRMBL(1)
      NBT=13
```

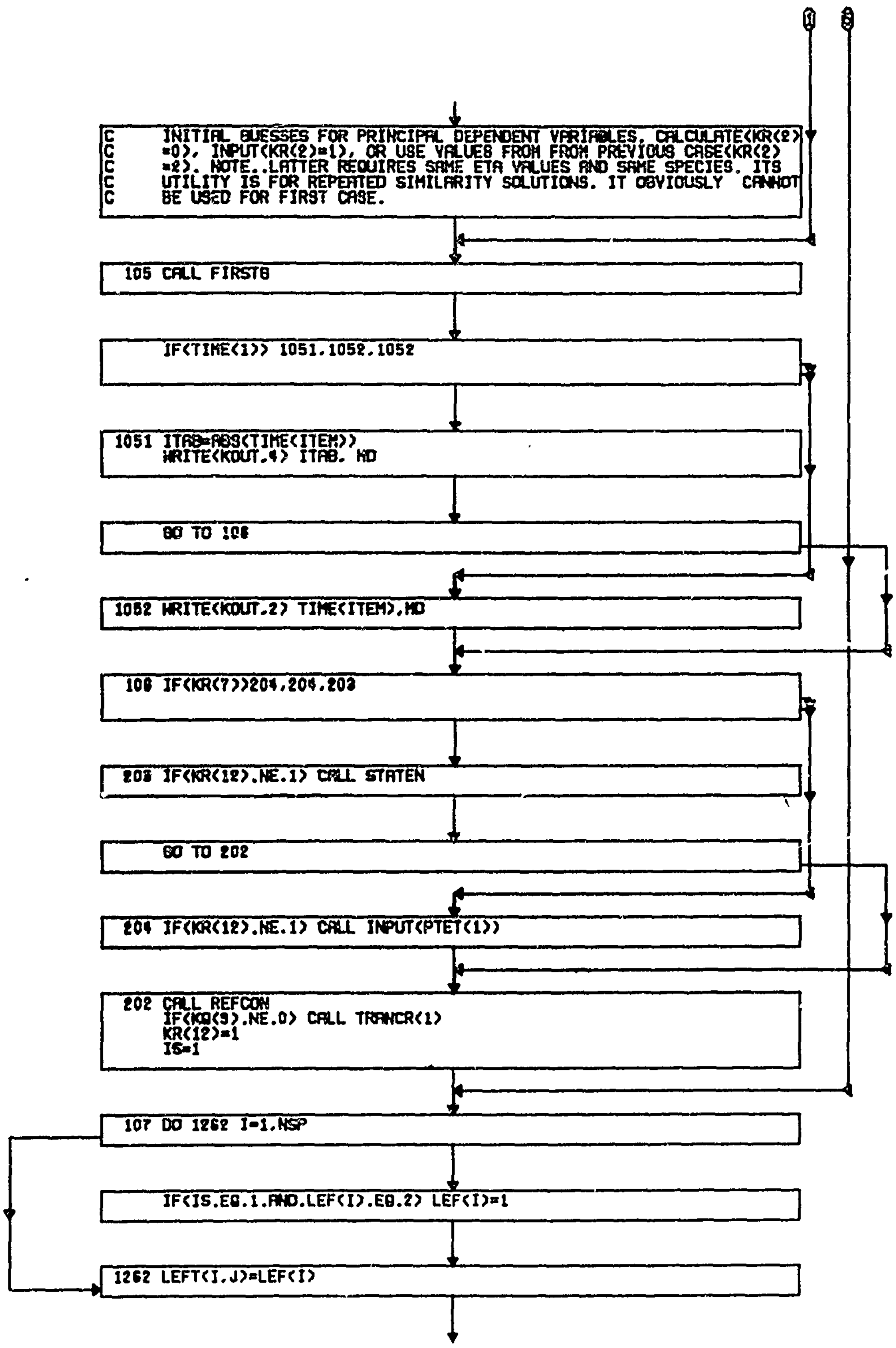
```
      NBT2=14
      IS=1
      IT=1
      IF(KR(1)) 104,104,103
  103 CALL LINMAT
  104 KR17=KR(17)
  154 IF(IS+ITEM-2) 105,105,1572
 1572 IF(KR(3)) 1570,1577,1570
 1570 IF(KR(6)-1) 1571,1571,1576
 1571 IF(IS-1) 1577,1577,1576
 1576 DO 1573 K=1,NSP
      IF(LEF(K)-1) 1573,1575,1573
 1575 LEF(K)=2
 1573 CONTINUE
 1577 IF(NITEM-1) 1574,107,1574
 1574 WRITE(NBT)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KQ(10)
      IF(ITEM-1) 157,156,157
  156 IDUM=NBT
      NBT=NBT2
      NBT2=IDUM
      DO 153 I=1,NITEM
  153 BACKSPACE NBT2
      GO TO 155
  157 IF(IS-1) 105,105,155
  155 READ(NBT2)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KQ(10)
      GO TO 107
  105 CALL FIRSTG
      IF(TIME(1)) 1051,1052,1052
 1051 ITAB=ABS(TIME(ITEM))
      WRITE(KOUT,4) ITAB, MD
      GO TO 106
 1052 WRITE(KOUT,2) TIME(ITEM),MD
  106 IF(KR(7))204,204,203
  203 IF(KR(12).NE.1) CALL STATEN
      GO TO 202
  204 IF(KR(12).NE.1) CALL INPUT(PTET(1))
  202 CALL REFCON
      IF(KQ(9).NE.0) CALL TRANCR(1)
      KR(12)=1
      IS=1
  107 DO 1262 I=1,NSP
      IF(IS.EQ.1.AND.LEF(I).EQ.2) LEF(I)=1
 1262 LEFT(I,J)=LEF(I)
C-----COMPUTE HISTORIC INFORMATION
      CALL HISTXI
      IF(TIME(1)) 1053,1054,1054
 1053 ITAB=ABS(TIME(ITEM))
      WRITE(KOUT,5) ITAB, S(IS), MD
      GO TO 126
 1054 WRITE(KOUT,3)TIME(ITEM),S(IS),MD
  126 DO 1261 I=1,NETA
 1261 THF(I,J)=HF(I,5)
      TXI(J)=XI(IS)
      TRADS(J)=RADS(IS)
      TDSIP(J)=DSIP(IS)
      TUE(J)=UE(IS)
      TRHOE(J)=RHOE(IS)
      TTE(J)=TE(IS)
      KQT(J)=KQ(10)
      TVMUE(J)=VMUE(IS)
```

```
      DO 184 I=1,566
  184 TMAT(I,J)=VMAT(I)
      TPE(J)=PE(IS,1)
      MWE=0
C     START OF ITERATION LOOP
  158 ITS=0
      KR(17)=KR17
  159 RETURN
      END
```

c. Flow Chart




1571 IF(IS-1) 1577,1577,1576
1576 DO 1573 K=1,NSP
IF(LEF(K)-1) 1573,1575,1573
1575 LEF(K)=2
1573 CONTINUE
1577 IF(NITEM-1) 1574,107,1574
1574 WRITE(NBT)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KG(10)
IF(ITEM-1) 157,156,157
156 IDUM=NBT
NBT=NBT2
NBT2=IDUM
DO 158 I=1,NITEM
158 BACKSPACE NBT2
GO TO 155
157 IF(IS-1) 105,105,155
155 READ(NBT2)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KG(10)
GO TO 107


C INITIAL GUESSES FOR PRINCIPAL DEPENDENT VARIABLES. CALCULATE(KR(2)
C =0), INPUT(KR(2)=1), OR USE VALUES FROM FROM PREVIOUS CASE(KR(2)
C =2). NOTE..LATTER REQUIRES SAME ETA VALUES AND SAME SPECIES. ITS
C UTILITY IS FOR REPEATED SIMILARITY SOLUTIONS. IT OBVIOUSLY CANNOT
C BE USED FOR FIRST CASE.
105 CALL FIRSTG
IF(TIME(1)) 1051,1052,1052
1051 ITAB=ABS(TIME(ITEM))
WRITE(KOUT,4) ITAB, MD
GO TO 108
1052 WRITE(KOUT,2) TIME(ITEM),MD
108 IF(KR(7))204,204,203
203 IF(KR(12).NE.1) CALL STATEN
GO TO 202
204 IF(KR(12).NE.1) CALL INPUT(PTET(1))
202 CALL REFCON
IF(KQ(9).NE.0) CALL TRANCR(1)
KR(12)=1
IS=1
107 DO 1262 I=1,NSP
IF(IS.EQ.1.AND.LEF(I).EQ.2) LEF(I)=1
1262 LEFT(I,J)=LEF(I)

```
C-----COMPUTE HISTORIC INFORMATION
      CALL HISTXI

      IF(TIME(1)) 1059,1054,1054

 1053 ITAB=ABS(TIME(ITEM))
      WRITE(KOUT,5) ITAB, S(IS), MD

      GO TO 126

 1054 WRITE(KOUT,3)TIME(ITEM),S(IS),MD

  126 DO 1261 I=1,NETA

 1261 THF(I,J)=HF(I,5)

      TXI(J)=XI(IS)
      TRADS(J)=RADS(IS)
      TDSIP(J)=DSIP(IS)
      TUE(J)=UE(IS)
      TRHOE(J)=RHOE(IS)
      TTE(J)=TE(IS)
      KGT(J)=KG(10)
      TVMUE(J)=VMUE(IS)

      DO 104 I=1,666

  104 TMAT(I,J)=VMAT(I)

      TPE(J)=PE(IS,1)
      MWE=0
C     START OF ITERATION LOOP
  158 ITS=0
      KR(17)=KR17

  159 RETURN

      END
```

3. SUBROUTINE ITERAT - B04A

a. Function

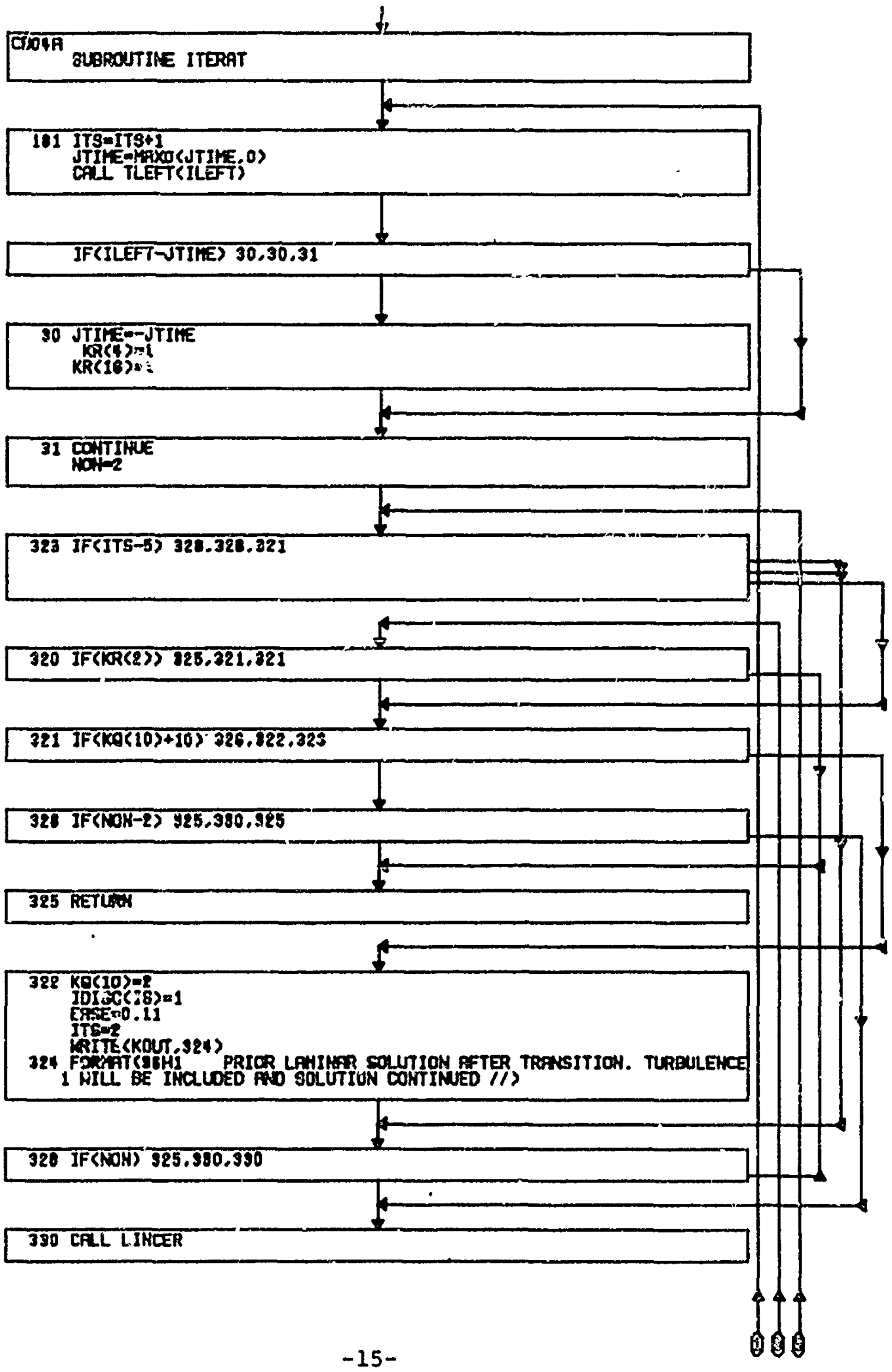
Control program for performing boundary layer iteration and tests maximum errors for convergence. Called by BLIMP. Calls LINCER, NONCER.

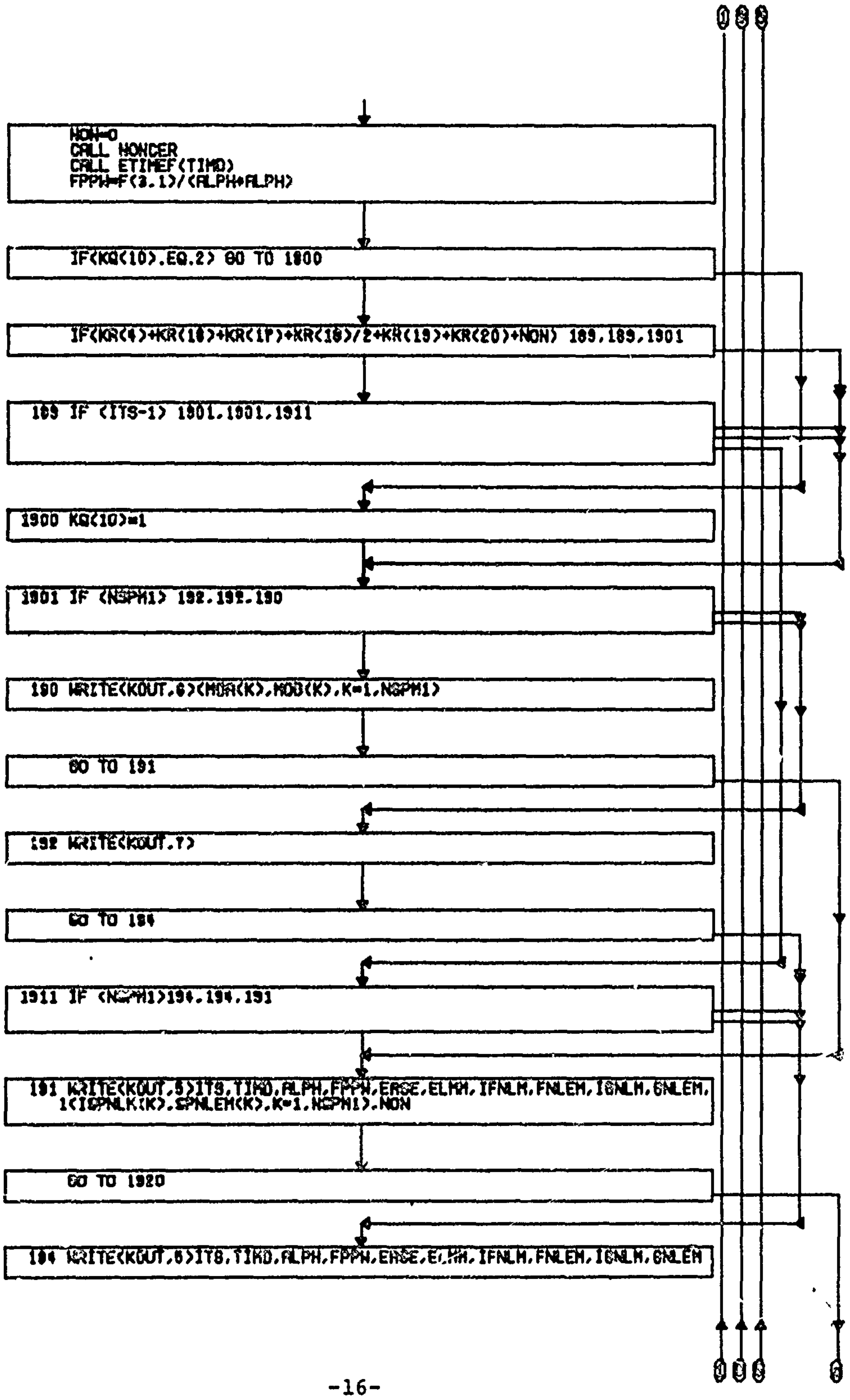
b. Listing

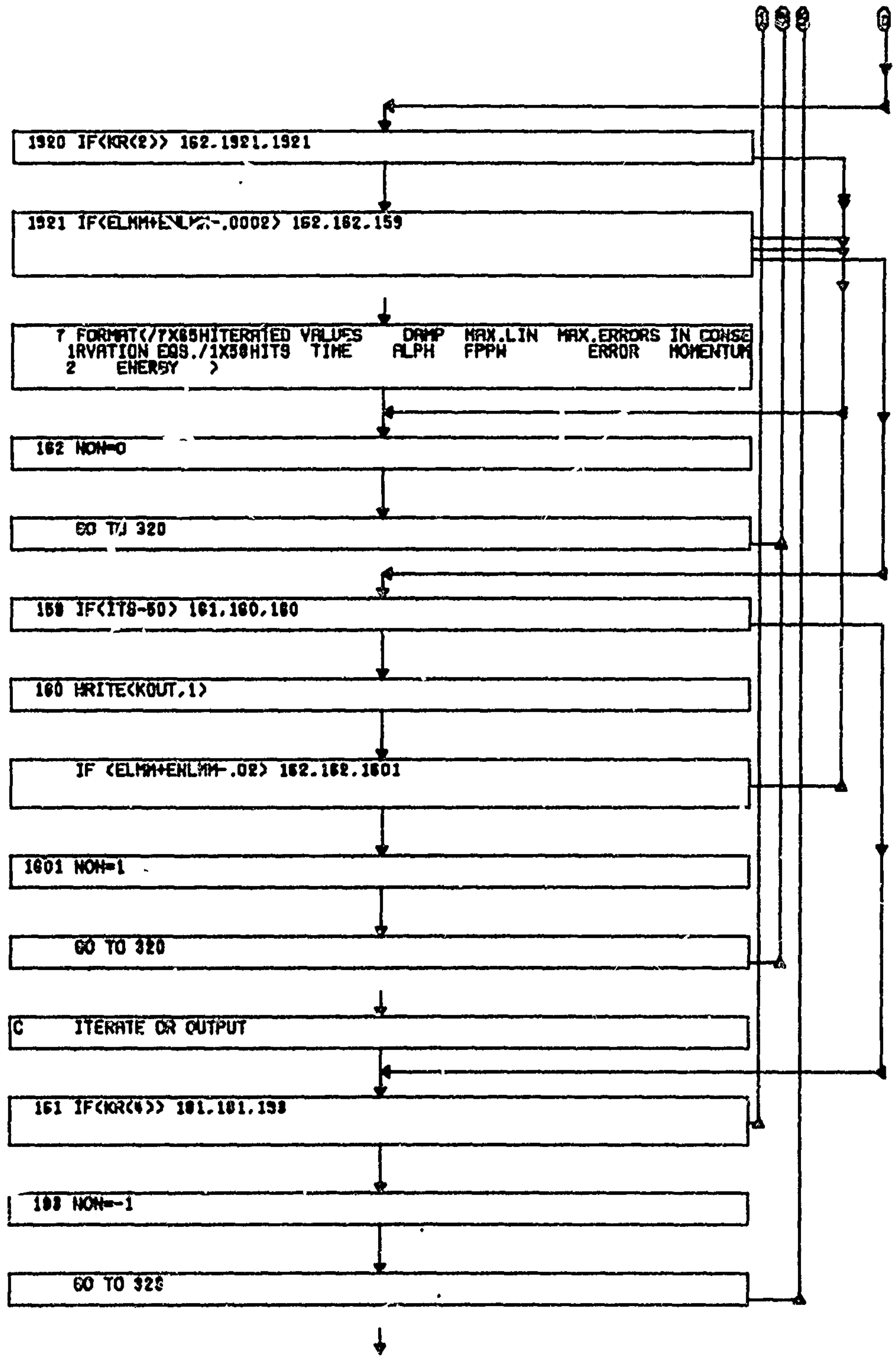
```
      CB04A                                                             B04A 001
      SUBROUTINE ITERAT                                                 B04A 002
      COMMON/BLQCOM/  MOA( 71),  MOB( 71),NSPEC,FR( 71,15),W(3),LEF(10) B04A   3
     1,LEFS(10),PIEASE,LEFW(10)                                         B04A   4
      COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IXB04A   5
      COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM     B04A   6
     1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)     B04A   7
     2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)      B04A   8
     3,FNLEM,GNLEM,SPNLEM( 8),           ENLMM,IFNLM,IGNLM,ISPNLM( 8)   B04A   9
     4,NENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)              B04A  10
      COMMON/INTCOM/ KR(23),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB04A  11
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B04A  12
     2,B(8),       MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B04A  13
     3,KAUXO,JTIME,JSPEC,MD(3)                                          B04A  14
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B04A  15
     1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B04A  16
     2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                            B04A  17
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B04A  18
    5 FORMAT(I3,1X,F8.3,F6.3,F7.4,F6.4,1PE7.0,8(I3,E8.1))
    6 FORMAT(/1X15HITERATED VALUES11X47HDAMP  MAX.LIN   MAX.ERRORS IN CO
     1NSERVATION EQS./1X56HITS   TIME   ALPH   FPPW        ERROR  MOMEN
     1TUM    ENERGY 6(5XA4,A2))
    1 FORMAT(22H NON-CONVERGENT OUTPUT)                                 B04A 018
  181 ITS=ITS+1                                                         B04A 019
      JTIME=MAX0(JTIME,0)
      CALL TLEFT(ILEFT)                                                 RDG
      IF(ILEFT-JTIME) 30,30,31
   30 JTIME=-JTIME
       KR(4)=1                                                          RDG
      KR(16)=1                                                          RDG
   31 CONTINUE                                                          RDG
      NON=2
  323 IF(ITS-5) 328,328,321
  320 IF(KR(2)) 325,321,321
  321 IF(KQ(10)+10) 326,322,326
  326 IF(NON-2) 325,330,325
  325 RETURN
  322 KQ(10)=2
      IDISC(IS)=1
      EASE=0.11
      ITS=2
      WRITE(KOUT,324)
  324 FORMAT(96H1     PRIOR LAMINAR SOLUTION AFTER TRANSITION, TURBULENCE
     1 WILL BE INCLUDED AND SOLUTION CONTINUED //)
  328 IF(NON) 325,330,330
  330 CALL LINCER
      NON=0
      CALL NONCER                                                       B04A 021
      CALL ETIMEF(TIMD)
      FPPW=F(3,1)/(ALPH*ALPH)                                           B04A 022
      IF(KQ(10).EQ.2) GO TO 1900
      IF(KR(4)+KR(16)+KR(17)+KR(18)/2+KR(19)+KR(20)+NON) 189,189,1901
  189 IF (ITS-1) 1901,1901,1911                                         B04A
 1900 KQ(10)=1
 1901 IF (NSPM1) 192,192,190                                            B04A
  190 WRITE(KOUT,6)(MOA(K),MOB(K),K=1,NSPM1)                            B04A 025
      GO TO 191
  192 WRITE(KOUT,7)
```

```
      GO TO 194
 1911 IF (NSPM1)194,194,191
  191 WRITE(KOUT,5)ITS,TIMD,ALPH,FPPW,EASE,ELMM,IFNLM,FNLEM,IGNLM,GNLEM,
     1(ISPNLM(K),SPNLEM(K),K=1,NSPM1),NON
      GO TO 1920
  194 WRITE(KOUT,5)ITS,TIMD,ALPH,FPPW,EASE,ELMM,IFNLM,FNLEM,IGNLM,GNLEM
 1920 IF(KR(2)) 162,1921,1921
 1921 IF(ELMM+ENLMM-.0002) 162,162,159                                  *NEW
    7 FORMAT(/7X65HITERATED VALUES    DAMP  MAX.LIN  MAX.ERRORS IN CONSE     **-1
     1RVATION EQS./1X58HITS  TIME    ALPH   FPPW        ERROR   MOMENTUM
     2     ENERGY   )
  162 NON=0                                                           B04A 029
      GO TO 320
  159 IF(ITS-50) 161,160,160                                          B04A 031
  160 WRITE(KOUT,1)                                                   B04A 032
      IF (ELMM+ENLMM-.02) 162,162,1601                                B04A 033
 1601 NON=1                                                           B04A 034
      GO TO 320
C     ITERATE OR OUTPUT                                               B04A 036
  161 IF(KR(4)) 181,181,193                                           B04A 037
  193 NON=-1                                                          B04A 038
      GO TO 323
      END                                                             B04A 040
```

c. Flow Chart


CΠO4A
SUBROUTINE ITERAT
101 ITS=ITS+1
JTIME=MAXO(JTIME,0)
CALL TLEFT(ILEFT)
IF(ILEFT-JTIME) 30,30,31
30 JTIME=-JTIME
KR(4)=1
KR(16)=
31 CONTINUE
NON=2
323 IF(ITS-5) 328.328.321
320 IF(KR(2)) 325,321,321
321 IF(KQ(10)+10) 326,322,323
328 IF(NON-2) 325,330,325
325 RETURN
322 KQ(10)=2
IDISC(28)=1
EASE=0.11
ITS=2
WRITE(KOUT,324)
324 FORMAT(36H1 PRIOR LAMINAR SOLUTION AFTER TRANSITION. TURBULENCE
1 WILL BE INCLUDED AND SOLUTION CONTINUED //)
328 IF(NON) 325,330,330
330 CALL LINCER


NON=0
CALL NONCER
CALL ETIMEF(TIMO)
FPPW=F(3.1)/(ALPH*ALPH)
IF(KQ(10).EQ.2) GO TO 1900
IF(KR(4)+KR(18)+KR(17)+KR(18)/2+KR(19)+KR(20)+NON) 189,189,1901
189 IF (ITS-1) 1901,1901,1911
1900 KQ(10)=1
1901 IF (NSPM1) 192,192,190
190 WRITE(KOUT,6)(MOR(K),MOD(K),K=1,NSPM1)
GO TO 191
192 WRITE(KOUT,7)
GO TO 194
1911 IF (NSPM1)194,194,191
191 WRITE(KOUT,5)ITS,TIMO,ALPH,FPPW,ERSE,ELMM,IFNLM,FNLEM,IGNLM,GNLEM,
1(ISPNLK(K),SPNLEM(K),K=1,NSPM1),NON
GO TO 1920
194 WRITE(KOUT,6)ITS,TIMO,ALPH,FPPW,ERSE,ELMM,IFNLM,FNLEM,IGNLM,GNLEM


1920 IF(KR(2)) 162.1921.1921
1921 IF(ELMM+ENLMM-.0002) 162.162.159
7 FORMAT(/7X65HITERATED VALUES DAMP MAX.LIN MAX.ERRORS IN CONSE
1RVATION EQS./1X58HITS TIME ALPH FPPW ERROR MOMENTUM
2 ENERGY)
162 NON=0
GO TO 320
159 IF(ITS-50) 161,160,160
160 WRITE(KOUT,1)
IF (ELMM+ENLMM-.02) 162.162.1601
1601 NON=1
GO TO 320
C ITERATE OR OUTPUT
161 IF(KR(4)) 181.181.193
193 NON=-1
GO TO 320

END

b. Listing

```
C       B05B
        SUBROUTINENONCER                                                 B05A0020
        INTEGER ASU,BSU
        DIMENSIONDQJRNL( 71,1)                                           B058 004
        DIMENSIONDELQJW(1) ,DQJNL(153,1) ,WALLQJ(1)                      B058 005
        DIMENSIONCOEEQV(84),COEFQV(423)                                  B058 006
        COMMON/BLOCOM/  MOA( 71),  MOB( 71),NSPEC,FR( 71,15),W(3),LEF(10) B058   7
       1,LEFS(10),PIEASE,LEFW(10)                                        B058   8
        COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IXB058   9
        COMMON/COECOM/                 C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B058  10
       1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB058  11
       232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4B058  12
       3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB058  13
       465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81B058  14
       5,C82,C83,C84,C85,C86,C87,C88                                     B058  15
        COMMON/COECON/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)   B058  16
       1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)     B058  17
       2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)  B058  18
       3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9) B058  19
       4,CKK3( 8, 8)                                                     B058  20
        COMMON/CRBCOM/HCARB,EMIS,STEF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMISTB058  21
       1,HPG,ASU(3),BSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(40),ISU           B058  22
        COMMON/EDGCOM/              PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B058  23
       1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90  B058  24
       2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                   B058  25
        COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,   B058  26
       1EPSA(15),EPS1,EL(15),DPI(15,2),DLI(153),DEPS(153),DEPC,TREF,RETR B058  27
        COMMON/EQPCOM/  RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B058  28
       1 TU( 71,2),FF( 71),FFA,IPC( 71),ATA(10),ATB(10),ATC(10),WAT(10), B058  29
       2 KAT(10),IR(10),IZ,KZ(10),LAMI( 71),P,Z,TK(10, 7),VN( 71),       B058  30
       3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),YYY( 71),YW( 71),GG( 71)B058  31
       4 ,TG(10, 7),EPOVRK,SIGMA,BASMOL                                  B058  32
        COMMON/EQTCOM/SIP,HIP,EEL,EENL,FLIQ,CPF,IRE,IER,AA,IITS,IN,IL,IIT,B058  33
       1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,BX,ISP2,ISPG,  B058  34
       2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HHG, B058  35
       3 CCPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),BB(16),   B058  36
       4 IP( 71),ALP(10),PNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS, B058  37
       5 CP( 71),HH( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),      B058  38
       6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JZ( 4)                    B058  39
        COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM    B058  40
       1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)    B058  41
       2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)     B058  42
       3,FNLEM,GNLEM,SPNLEM( 8),            ENLMM,IFNLM,IGNLM,ISPNLM( 8) B058  43
       4,NENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)             B058  44
        COMMON/ETACOM/ETA(15),DETA(15),DSG(14),DCU(14),B1(14),B2(14)     B058  45
       1,LAR(153),BA1(43,18),BA2(30,15)                                  B058  46
        COMMON/FLXCOM/DELQW,DELJW( 8),DQNL(153),DJNL(153, 8),WALLQ       B058  47
       1,WALLJ( 8),QW,VJKW( 9),TPWALL                                    B058  48
        COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8B058  49
       1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2 B058  50
       2,C3M(40),BETAM(40)                                               B058  51
        COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB058  52
       1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B058  53
       2,B(8),       MWE,NON,KQ(10),ITEM,NITEM,KR17,NST,NST2,IDENT,KR9(40) B058  54
       3,KAUXO,JTIME,JSPEC,MD(3)                                         B058  55
        COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                         B058  56
       1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)              B058  57
        COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),GR(15),H(15)  B058  58
```

```
      1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB05B  59
      2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B05B  60
      3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)   B05B  61
      4,DPHIKK( 8, 8),       DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL  B05B  62
      5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B05B  63
      6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B05B  64
       COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B05B  65
       COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         B05B  66
      1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      B05B  67
       DIMENSION ENLM(1),IENLM(1)
       EQUIVALENCE (ENLM(1),FNLEM),(IENLM(1),IFNLM)
       EQUIVALENCE(DELQW,DELQJW),(DQNL,DQJNL),(WALLQ,WALLQJ)             B05A0380
       DIMENSIONCORAR(1)                                                 B05A0470
       EQUIVALENCE(CORAR(1),AM(1))                                       B05A0480
       EQUIVALENCE(AM,DQJRNL)                                            B05A0490
       DIMENSION PREG(1)
       DIMENSION ZEIT(9)
       EQUIVALENCE(PREG(1),DRHOH)                                        B05B
       EQUIVALENCE(C5,COEEQV),(CK1(1),COEFQV)                            B05A0680
C**NB***NOTE 240+1,540+1,725,730+1 WHEN REDIMENSIONING                   B05A0690
       EASE=AMIN1(EASE*2.,1.0)
       IF(ITS-1) 11,5,11
     5 EASE = .3333                                                      B05A0730
       SPNEW = 0.
       BUMP = 1.0                                                        B05A0740
       IF(ITEM+IS-2) 3,3,2
     2 IF(WDOT) 4,3,3
     3 WDOT=-.12/C1
     4 PIEASE=1.
       ICORM = 1                                                         B05A0760
       CORMA = 1.E + 10                                                  B05A0770
       TFZ = 0.                                                          B05A0780
       IF (KR9(IS)) 8,8,7
     7 KR(9)=KR9(IS)
     8 DO 17 I=1,NETA
    17 EPSA(I)=0.
       IF(KR(9)-2) 11,10,9
     9 FLUXJ(3,IS,IT)=-1.                                                B05A0785
    10 ISP=IZ+1
       KK=MAX0(1,KS(IS))
       W(1) = FLUXJ(1,IS, IT)
       W(2)=FLUXJ(2,IS,IT)                                                    *NEW
       W(3)=FLUXJ(3,IS,IT)                                                    *NEW
       L2=2*KK                                                                **-2
       L3=L2+1
       IF(KR(9)-2) 11,11,16
    16 HPG=HPYG(KK)
       EMISC=EMIV(KK)
       HCARB=HCHAR(KK)
       DO 12 J=ISP,NSPEC
       IF(MOA(J)-ABU(KK)) 12,13,12
    13 IF(MOB(J)-BBU(KK)) 12,14,12
    14 ISU=J
       GO TO 11
    12 CONTINUE
       ISU=ISP
    11 KIP=0
       IX = 0                                                            B05A0810
C----  EVALUATE COEFFICIENTS AND ERRORS FOR NONLINEAR EQUATIONS          B05A0830
C      INITIALIZE AM MATRIX                                              B05A0840
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```
      DO 15 I=1,NNLEQ                                                   B05A0850
      ENL(I)=0.
      DO 15 J=1,NNLEQ                                                   B05A0860
   15 AM(I,J) = 0.                                                      B05A0870
C     EVAL. GROUPINGS WHICH CHANGE DURING ITERATION BUT ARE NOT F(ETA)  B05A0880
   40 C5 = 1. / ALPH                                                    B05A0940
      DUM1 = ALPH * ALPH                                                B05A0950
      C6 = BETA * DUM1                                                  B05A0960
      C7 = - UE(IS) / DUM1 * UE(IS) / 25036.5                           B05A0970
      C8 = ALPHD * C5                                                   B05A0980
      C9 = C4 - C8                                                      B05A0990
      C90 = ALPH * DUEDGE                                               B05A1000
      UKAP=UEDGE
C---- EVAL COEFS, AM, AND ERRORS FOR EDGE BOUN CONDS AND ALPH CONSTRAINTB05A1010
C     FIRST, COMPUTE UEDGE IF THERE IS AN ENTROPY LAYER                 B05A1020
COMMENT-----PERFORM TABLE LOOKUP FOR UEDGE (WHICH IS A FUNCTION OF      B05A1030
COMMENT-----F(1,NETA),IS,AND IT), DIFFERENTIATE TO GET DUEDGE, AND      B05A1040
COMMENT-----DIFFERENTIATE AGAIN TO GET D2UEDG                           B05A1050
C     NEXT,  EVALUATE NONLINEAR ERRORS                                  B05A1060
   45 ENL(4)=-(ALPH*UEDGE-F(2,NETA))
      ENL(5)=-F(2,1)
      IF(KR(10)-2) 41,41,42
   41 ENL(2)=-(F(2,KAPPA)-CBAR*ALPH*UKAP)
      AM(2,KAPPA+3)=1.
      AM(2,1)=-CBAR*UKAP
      GO TO 43
   42 ENL(2)=-F(3,NETA)
      CALL LIAD(-1,2,NETA+NETA-2,1,)
   43 AM(4,1)=UEDGE
      AM(4,MAT1J)=-1
      AM(3,4)=1.
C     FINALLY, EVAL CONTRIBUTIONS TO AM AND ERRORS FROM OTHER COEFFS    B05A1140
      CALL LIAD(-1,NETA+1,NETA-1,C90)
C---- START OF MAJOR DO LOOP FOR EVAL OF COEFFS AND ERRORS AT EACH ETA  B05A1290
      KQ(1)=2
      KQ(5)=0
      CALL ETIMEF(ZEIT(1))
      DO 49 I=1,NETA
      H(I)=G(1,I)+0.5*F(2,I)*C7*F(2,I)
      HP=G(2,I)+F(2,I)*C7*F(3,I)
      IF(KR(7)) 47,47,46
   46 CALL STATE
      GO TO 48
   47 CALL EQUIL(KQ,H(I),PE(IS,IT))
   48 IF(I-1) 50,50,54
   50 IF(NSPM1) 53,53,51
   51 DO 52 K=1,NSPM1
      DO 31 KK=1,NSP
   31 DLPK(K,KK) = A(KK+2, K+2)
   52 DTKW(K)= DTK(K)
      DO 32 KK=1,NSP
   32 DLPH(KK)= A(KK+2,1)
      VLNKW=VLNK(ISU)
      TCW=TC(ISU)
      HCWAL = HH(ISU)/WTM(ISU)*1.8
   53 DTHW=DTH
   54 RHOP(I)=DRHOH*HP
      IF(NSPM1) 58,58,56
   56 DO 57 K=1,NSPM1
   57 RHOP(I)=RHOP(I)+DRHOK(K)*SP(2,I,K)
```

```
   58 L=0
      M=MAT1J+I-MAT2J

      DO 49 MM=1, 9                                                     B058
      M=M+MAT2J


      DO 49 N=124,153                                                   B058
      L=L+1
   49 AM(M,N)=PREQ(L)
      CALL ETIMEF(ZEIT(2))
      IF(KQ(10).GT.0) CALL TRMBL(2)
      CALL ETIMEF(ZEIT(3))
      TTVC=1.0
      DO 120 I=1,NETA                                                   B05A1300
      L=0
      M=MAT1J+I-MAT2J

      DO 59 MM=1, 9                                                     B058
      M=M+MAT2J


      DO 59 N=124,153                                                   B058
      L=L+1
      PREQ(L)=AM(M,N)
   59 AM(M,N)=0.
C     TEST TO BYPASS COMMANDS THAT CANNOT BE PERFORMED AT ETA(1)        B05A1310
      IF (I - 1) 60,60,55                                               B05A1320
   55 CALL IMONE                                                        B05A1330
      IF(KQ(9).NE.0) CALL TRANCR(3)
      IF(KQ(10).GT.0) CALL TRMBL(4)
C     COMPUTE STATIC ENTHALPY AND DETERMINE STATE OF GAS                B05A1340
   60 C10 = C7 * F(2,I)                                                 B05A1350
      C13 = C7 * F(3,I)                                                 B05A1370
      HP = G(2,I) + F(2,I) * C13                                        B05A1380
C---- EVAL GROUPINGS WHICH ARE USED AT I-1 AS WELL AS AT I              B05A1460
   75 CALL ICOEFF                                                       B05A1470
      IF(KQ(9).NE.0) CALL TRANCR(2)
      IF(KQ(10).GT.0) CALL TRMBL(3)
      IF (I - 1) 100,80,100                                             B05A1480
C     DLPK,TCW,VLNKW,DLPH, AND Y1 NEEDED ONLY FOR CARBON PROBLEM         B05A1490
   80 IF (NSPM1) 95,95,85                                               B05A1500
   85 DO 90 K=1,NSPM1                                                   B05A1510
      WALLJ(K) = CK6(K)                                                 B05A1520
      VJKW(K) = CK6(K) / C3                                             B05A1530
   90 CONTINUE
   95 WALLQ = C32                                                       B05A1620
      QW = C32 / C3                                                     B05A1630
      TPWALL = TP
      GOTO 105                                                          B05A1640
C---- BACK TO CONSERVATION EQUATIONS                                    B05A1650
  100 CALL IONLY                                                        B05A1660
      IF(KQ(10).GT.0) CALL TRMBL(5)
      IF(KQ(9).NE.0) CALL TRANCR(4)
  105 IF (KR(17)) 120,120,115                                           B05A1670
  110 FORMAT(21H ALL THE COEFFICIENTS/(1X1P12E10.3))                    B05A1680
  115 WRITE(KOUT,110)C1,C2,C3,C4,COEEQV,COEFQV                          B05A1690
      IX = - 2                                                          B05A1700
  120 CONTINUE                                                          B05A1710
      CALL ETIMEF(ZEIT(4))
```

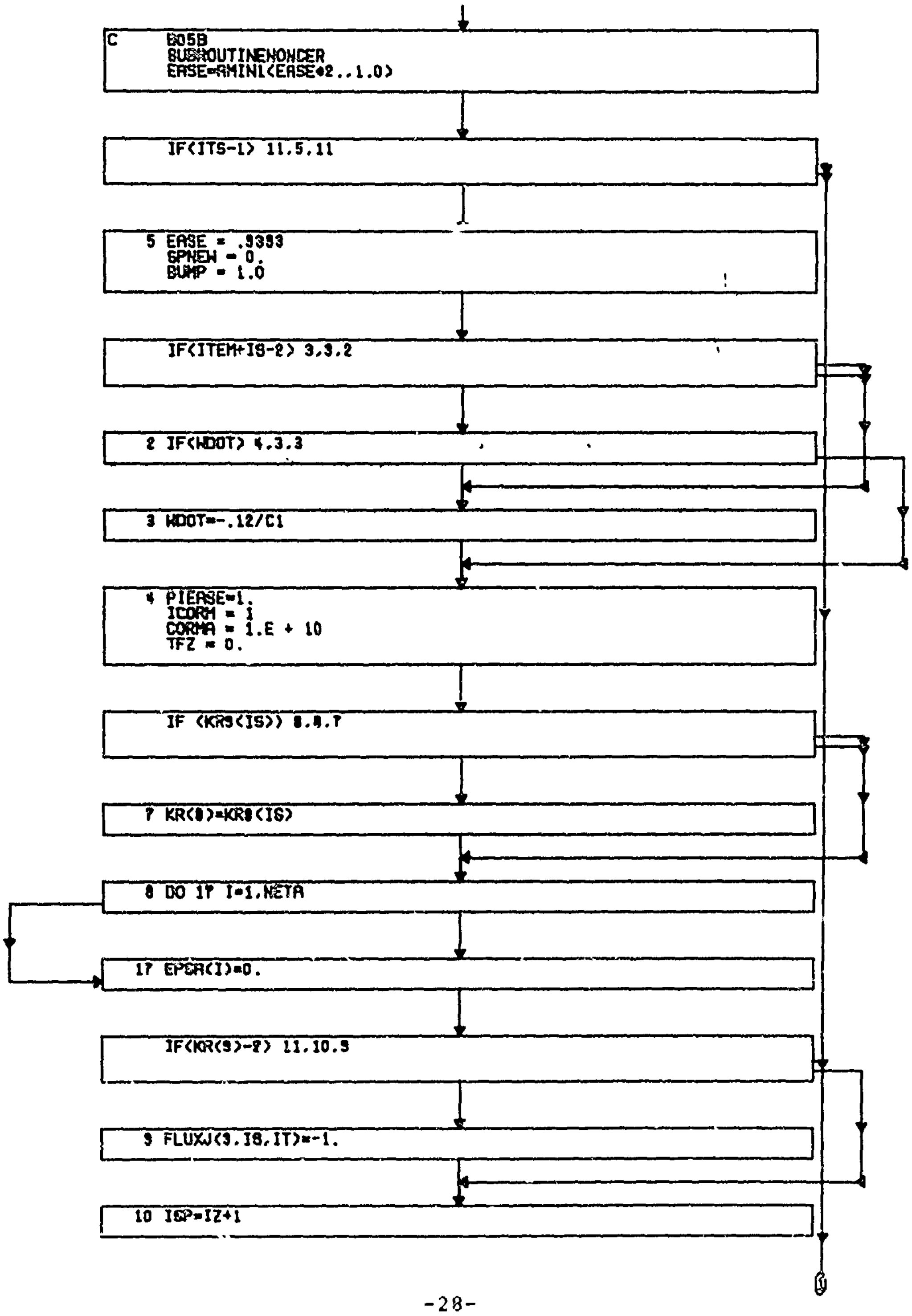
```
      IF (ITS - 1) 125,125,145                                          B05A1720
  125 DO 140 K=1,NSP                                                    B05A1730
      IF (LEFS(K)) 130,130,140                                          B05A1740
  130 IF(LEF(K)) 140,140,135
  135 EASE = .05                                                        B05A1760
      SPNEW = .14
  140 CONTINUE                                                          B05A1770
  145 IF(KR(19)) 170,190,170                                            B05A1850
  170 CONTINUE                                                          B05A1860
      WRITE(KOUT,175)                                                   B05A1870
  175 FORMAT(2X21HDEBUG FNLE,GNLE,SPNLE)                                B05A1880
  180 FORMAT(/2X1P11E10.3/(12X1P10E10.3))                               B05A1890
      WRITE (KOUT,180) (ENL(I),I=1,NNLEQ)
C     SEEK MAXIMUM ERROR FOR EACH CONSERVED QUANTITY
  190 M=2
      MM=MAT1J
      DO 200 I=1,NRNL
      CALL ABMAX(MM-1,ENL(M),ENLM(I),IENLM(I))
      IENLM(I) = IENLM(I)+1
      M=M+MM
  200 MM=MAT2J
C     SOLVE REDUCED SET OF EQUATIONS                                    B05A2070
      IF (KR(2).LT.0) RETURN
C     SCRUNTCH DEFINED ROWS OF AM MATRIX TO THE TOP                     B05A2090
      LSKIP=MAT1J+1                                                     B05A2100
      L=1                                                               B05A2110
      LL=0
      DO 240 M=1,NAM                                                    B05A2130
      L=L+1                                                             B05A2140
      IF(L-LSKIP) 235,230,235
  230 LSKIP=LSKIP+MAT2J
      LL=LL+1
      DO 231 J=1,NNLEQ
  231 DQJNL(J,LL)=AM(L,J)
      DELQJW(LL)=-ENL(L)
      L=L+1
  235 ENL(M)=ENL(L)
      DO 240 J=1,NNLEQ
  240 AM(M,J)=AM(L,J)                                                   B05A2180
C     THE FOLLOWING ROUTINE REARRANGES COLUMNS OF THE NOW RECTANGULAR   B05A2250
C     AM MATRIX,ACCORDING TO LAR,INVERTS((AM(I,J),J=2,NAM),I=1,NAM) AND B05A2260
C     MULTIPLIES THE INVERSE TIMES THE REMAINING COLUMNS OF AM MATRIX   B05A2270
C     AND TIMES THE ENL.                                                B05A2280
      CALL ETIMEF(ZEIT(5))
      CALL RERAY(NAM,AM,NSP + 1,ENL,1,LAR,IX,153)                       B05A2290
      CALL ETIMEF(ZEIT(6))
      DO 243 I=1,NAM
  243 AM(I,NAM)=AM(I,1)
  244 IF(KR(17)) 245,265,245
  245 CONTINUE                                                          B05A2310
  250 FORMAT(2X1P11E10.3)                                               B05A2320
      WRITE(KOUT,255)                                                   B05A2330
  255 FORMAT(2X18HDEBUG FLE,GLE,SPLE)                                   B05A2340
      WRITE(KOUT,250)FLE,GLE                                            B05A2350
      IF (NSPM1) 265,265,260                                            B05A2360
  260 WRITE(KOUT,250)((SPLE(I,K),K=1,NSPM1),I=1,MAT2J)                  B05A2370
C*****SURFACE OPTIONS TREATED IN RNLCER WITH REDUCED NONLINEAR SET
  265 CALL ETIMEF(ZEIT(7))
      CALL RNLCER
      CALL ETIMEF(ZEIT(8))
```

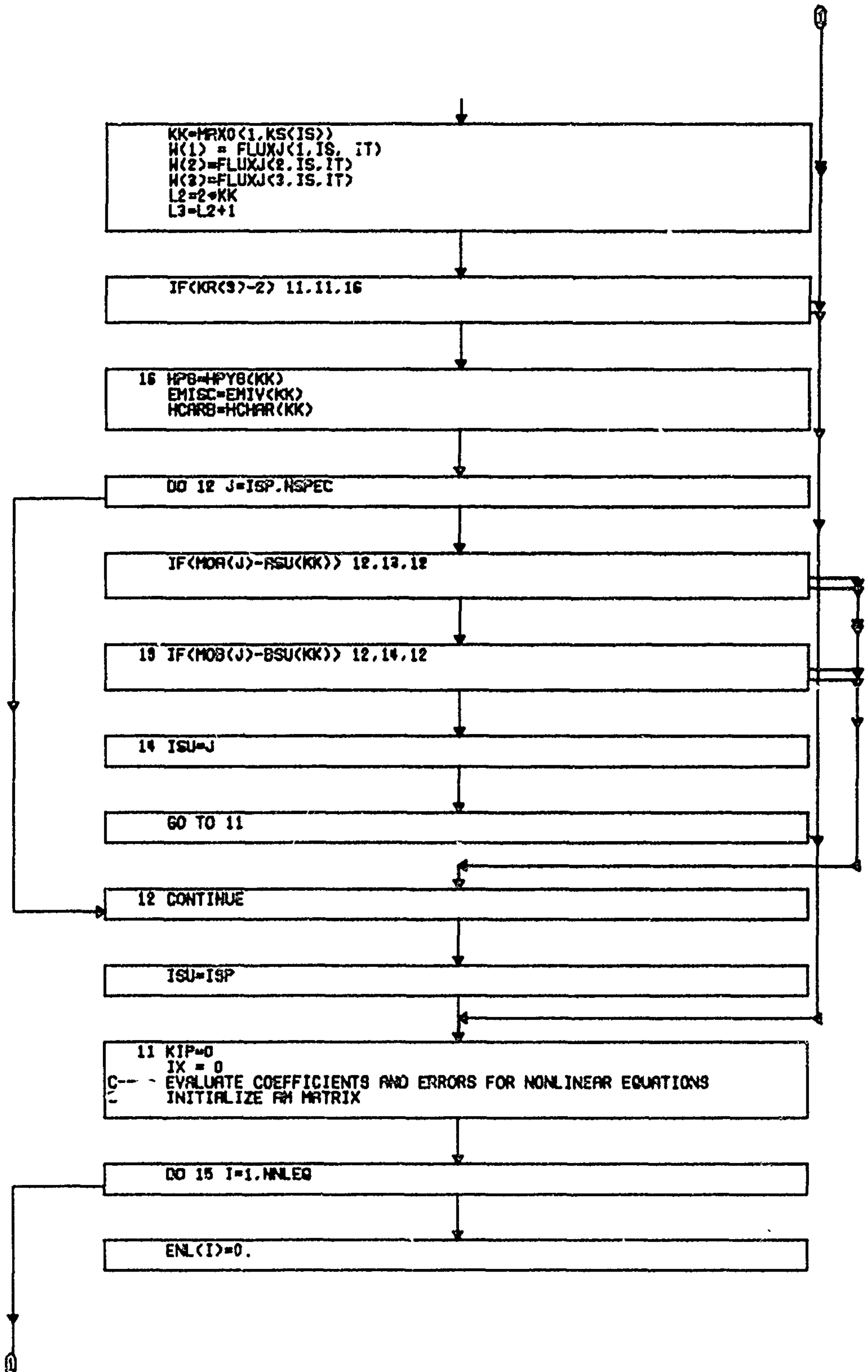
```
      C     DETERMINE MAXIMUM NONLINEAR ERRORS                              B05A4010
      C     EQUIVALENCE ENLM TO FNLEM, GNLEM, AND SPNLEM                    B05A4020
        595 DO 605 I=1,NRNL
            IF(ABS(ENLM(I))-ABS(DRNL(I))) 600,605,605
        600 ENLM(I) = DRNL(I)
            IENLM(I) = 1
        605 CONTINUE
            ENLM(1)=ENLM(1)*10.
            ENLM(2)=ENLM(2)/1000.                                                   *NEW
            CALL ABMAX(NRNL,ENLM,ENLMM,INLMM)                                       **-1
            ENLMM=ENLMM/10.
            ENLM(1)=ENLM(1)/10.
            ENLM(2)=ENLM(2)*1000.                                                   *NEW
            ELMM = ABS(ELMM)                                                B05A4160**-1
            BIP = KIP
            ENLMM = ABS(ENLMM) + 3. * BIP
      C     EVALUATE NONLINEAR CORRECTIONS FROM THE REDUCED SET             B05A4180
            DO 615 I=1,NAM                                                  B05A4190
            L = LAR(I)                                                      B05A4200
            DVNL(L) = ENL(I)                                                B05A4210
            DO 615 K=1,NRNL                                                 B05A4220
            J = K + NAM                                                     B05A4230
        615 DVNL(L) = DVNL(L) - DRNL(K) * AM(I,J)                           B05A4240
            DO 620 K=1,NRNL                                                 B05A4250
            I = NAM + K                                                     B05A4260
            J = LAR(I)                                                      B05A4270
        620 DVNL(J) = DRNL(K)                                               B05A4280
      C-----RECYCLE IF ALPH WANTS TO GO NEGATIVE
            IF(DVNL(1)+0.9*ALPH) 626,626,629
        626 DELQJW(1)=0.
            DO 627 K=1,NSPM1
            WALLJ(K)=VJKW(K)*C3
        627 DELQJW(K+1)=0.
            LIM=NAM+1
            DO 628 I=2,NNLEQ
            DUM=AM(I,NAM)/AM(1,NAM)
            ENL(I)=ENL(I)-ENL(1)*DUM
            DO 628 J=LIM,NNLEQ
        628 AM(I,J)=AM(I,J)-DUM*AM(1,J)
            ENL(1)=0.
            DO 631 J=LIM,NNLEQ
        631 AM(1,J)=0.
            ITS=ITS+1
            EASE=0.2
            IF(ITS-51) 244,244,850
        629 CONTINUE
      C-----EVALUATE LINEAR CORRECTIONS                                     B05A4300
            DO 630 I=1,MAT1I                                                B05A4310
            DO 630 J=1,MAT1J                                                B05A4320
        630 FLE(I) = FLE(I) - DVNL(J) * BA1(I,J)                            B05A4330
            JJ = MAT1J                                                      B05A4340
            DO 635 J=1,MAT2J                                                B05A4350
            JJ = JJ + 1                                                     B05A4360
            DO 635 I=1,MAT2I                                                B05A4370
        635 GLE(I) = GLE(I) - DVNL(JJ) * BA2(I,J)                           B05A4380
            CORAR(1)=DVNL(1)/ALPH*0.5
            L=NETA
            J=MAT1J+2
            DO 640 I=2,NETA
            CORAR(I)=DVNL(J)/10000.
```

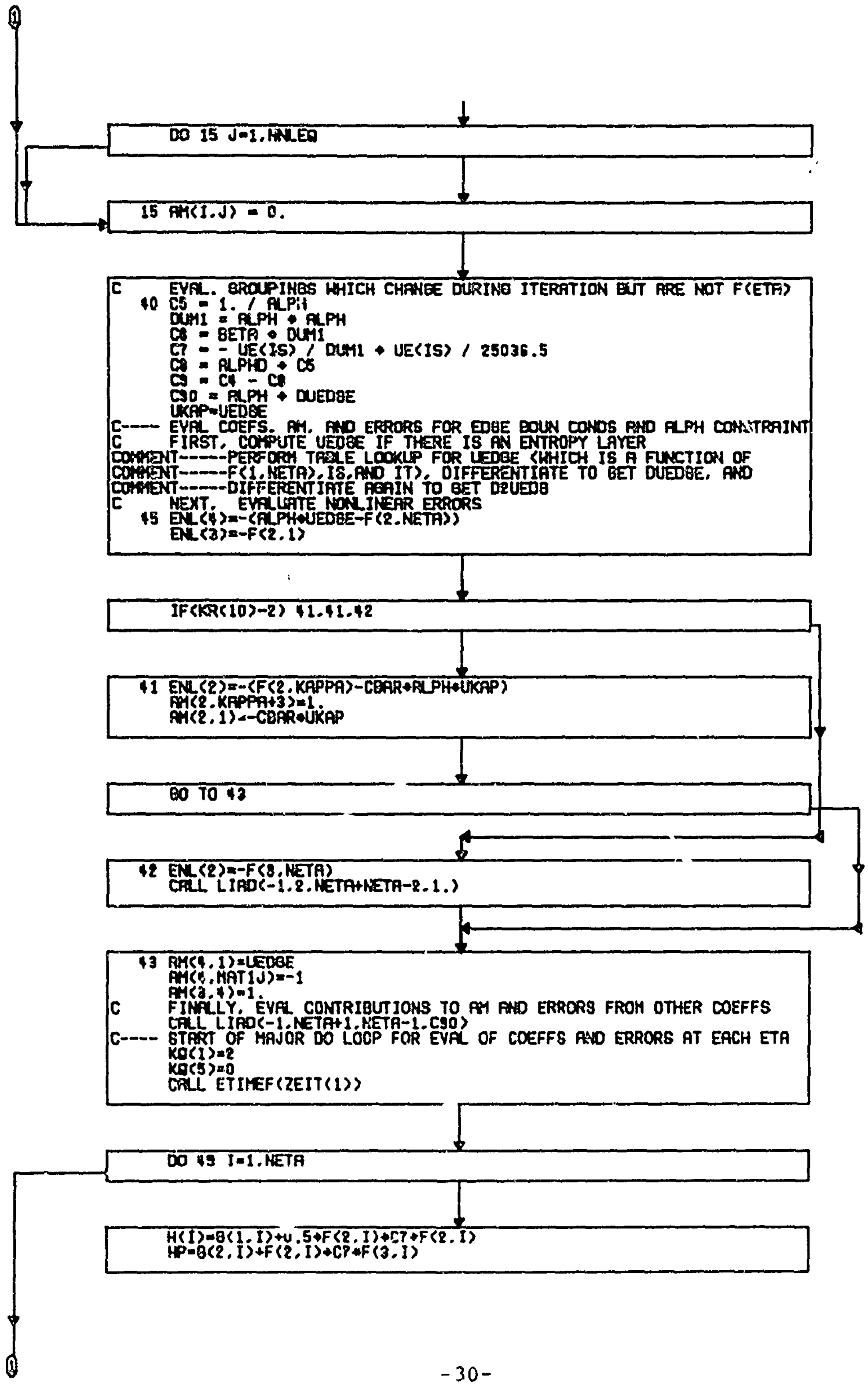
```
  640 J=J+1
      IF (NSPM1) 665,665,645                                              B05A4430
  645 DO 650 K=1,NSPM1                                                    B05A4440
      DO 650 J=1,MAT2J                                                    B05A4450
      JJ = JJ + 1                                                         B05A4460
      DO 650 I=1,MAT2I                                                    B05A4470
  650 SPLE(I,K) = SPLE(I,K) - DVNL(JJ) * BA2(I,J)                         B05A4480
      J=MAT1J+K*MAT2J+2
      DO 655 I=2,NETA                                                     B05A4510
      L = L + 1                                                           B05A4520
      CORAR(L)=DVNL(J)
  655 J=J+1
  660 CONTINUE                                                            B05A4540
  665 CONTINUE                                                            B05A4550
      IF(EASE-0.2) 673,670,670
  670 IF(0.33*CORAR(ICORM)/CORMA) 671,675,675
  671 BUMP=BUMP*2.0
      GO TO 675
  673 IF(ABS(1.0-CORAR(ICORM)/CORMA)-0.25) 674,674,675
  674 BUMP=BUMP/2.
  675 CALL ABMAX(L,CORAR,CORMA,ICORM)                                     B05A4580
      IF (KR(17)) 680,680,685                                             B05A4590
  680 IF (KR(19)) 690,705,690                                             B05A4600
  685 CONTINUE                                                            B05A4610
      KR(17) = KR(17) - 1                                                 B05A4620
  690 CONTINUE                                                            B05A4630
  695 FORMAT(2X38HDEBUG CORRECTIONS RNL,NL,FL AND GL,SPL)                 B05A4640
      CALL ETIMEF(ZEIT(9))
      WRITE(KOUT,696) ZEIT
  696 FORMAT(5X33HTIMES BEFOR AND AFTER . . . . . ./6X 9HCHEMISTRY9X
     1  13HERRORS+MATRIX9X9HINVERSION12X6HRNLCER11X3HNOW/10F10.4)
      WRITE(KOUT,695)                                                     B05A4650
      WRITE(KOUT,250)DRNL                                                 B05A4660
      WRITE(KOUT,250)DVNL                                                 B05A4670
      WRITE(KOUT,250)FLE,GLE                                              B05A4680
      IF (NSPM1) 705,705,700                                              B05A4690
  700 WRITE(KOUT,250)((SPLE(I,K),K=1,NSPM1),I=1,MAT2I)                    B05A4700
  705 CONTINUE                                                            B05A4710
C     CORRECT PRIMARY VARIABLES                                           B05A4720
      DUM = .05 / BUMP                                                    B05A4730
      EASE=AMIN1(1.5*EASE,1.0,DUM/ABS(CORMA))
      IF(ITS.EQ.2) BUMP=AMAX1(BUMP,.03/ABS(CORMA))                            *NEW
  710 IF (KR(13)) 720,720,715                                             B05A4750
  715 DUM = KR(13)                                                        B05A4760
      EASE = AMIN1(DUM / 10.,EASE)                                        B05A4770
  720 IF (EASE - 1.0) 725,740,740                                         B05A4780
  725 DO 730 I=1,313                                                      B05A4790
  730 FLE(I) = FLE(I) * EASE                                              B05A4800
      DO 735 I=1,153                                                      B05A4810
  735 DVNL(I) = DVNL(I) * EASE                                            B05A4820
  740 CONTINUE                                                            B05A4830
      PIEASE = PIEASE * (1. - EASE)                                       B05A4840
      IF (TFZ) 745,750,750                                                B05A4850
  745 TFZ = EASE * DTEMP - TFZ                                            B05A4860
  750 NUL=0
      DO 790 I=1,NETA
      NI=NETA+I
      N2I=NETA+NI-2
      F(2,I)=F(2,I)+DVNL(I+3)
      F(4,I)=F(4,I)+FLE(N2I)
```

```
      IF(I-1) 760,760,765
  760 F(1,1)=F(1,1) + DVNL(2)
      F(3,1)=F(3,1)+DVNL(3)
      GO TO 770
  765 F(1,I)= F(1,I)+FLE(I-1)
      F(3,I)=F(3,I)+FLE(NI-2)
  770 LPI=MAT1J+I+1
      DO 785 K=NUL,NSPM1
      IF(I-NETA) 772,771,772
  771 SP(1,I,K)=SP(1,I,K)+SPLE(1,K)
      GO TO 773
  772 SP(1,I,K)=SP(1,I,K)+DVNL(LPI)
  773 SP(3,I,K)=SP(3,I,K)+SPLE(NI,K)
      IF(I-1) 775,7**,780
  775 SP(2,1,K)= SP(2,1,K) + DVNL(LPI-1)
      GO TO 785
  780 SP(2,I,K)=SP(2,I,K)+SPLE(I,K)
  785 LPI=LPI+MAT2J
  790 CONTINUE
      ALPH=ALPH+DVNL(1)
      IF (ITS - 49) 850,840,850                                          805A9300
  840 IF (I777 - 777) 845,850,845                                        805A5310
  845 I777 = 777                                                         805A5320
      ITS = 30                                                           805A5330
  850 CONTINUE                                                           805A5340
      IF(KQ(10).GT.-1) RETURN
      RETHMO=-C3*RHOE(IS)*UE(IS)*(F(1,NETA)-F(1,1)-XM(S)/ALPH)
      IF(RETHMO.GT.RETR) KQ(10)=-10
      IF(RETHMC.LT.RETR) KQ(10)=-1
      RETURN                                                             805A5350
      END                                                                805A5360
```

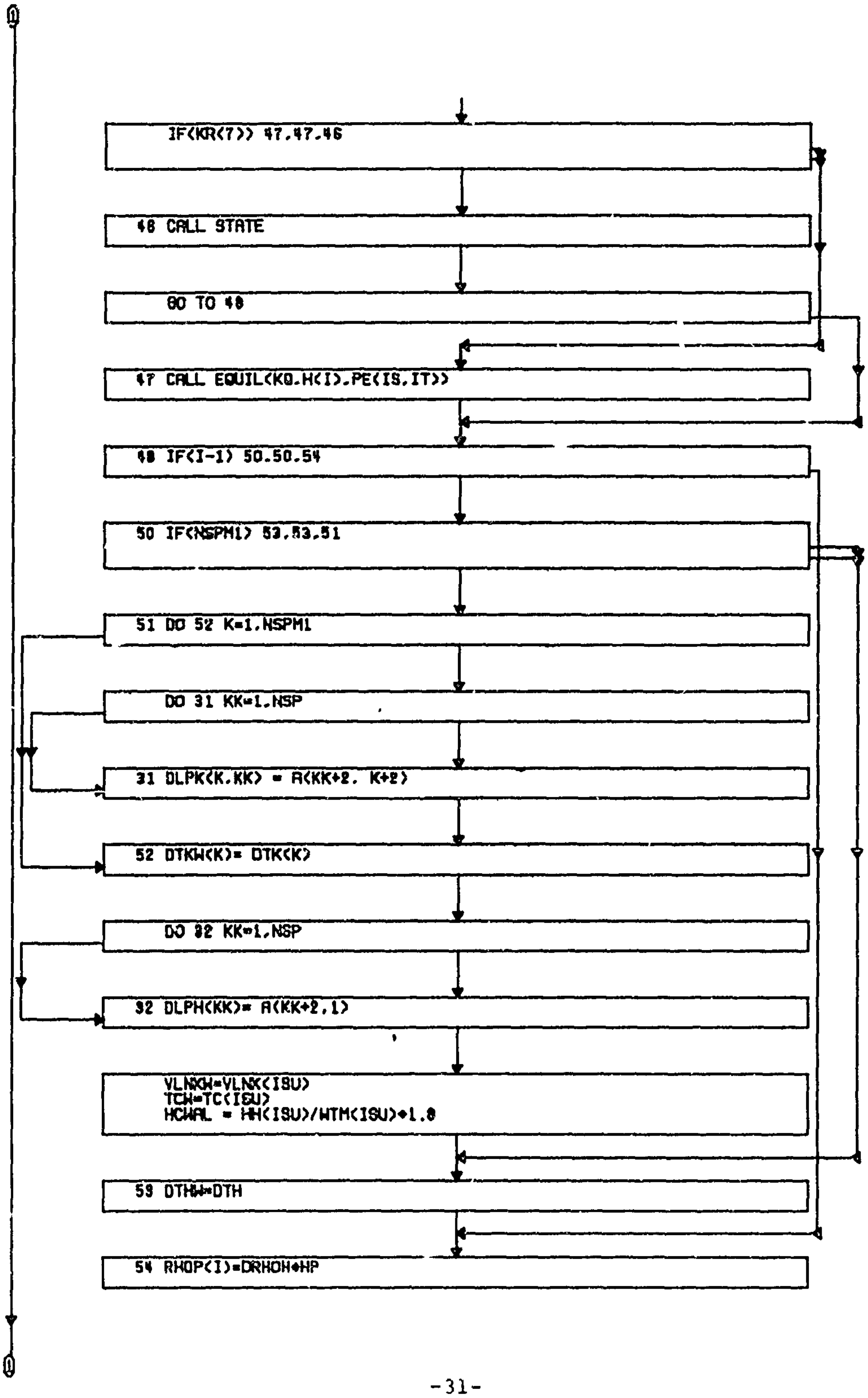
c. Flow Chart

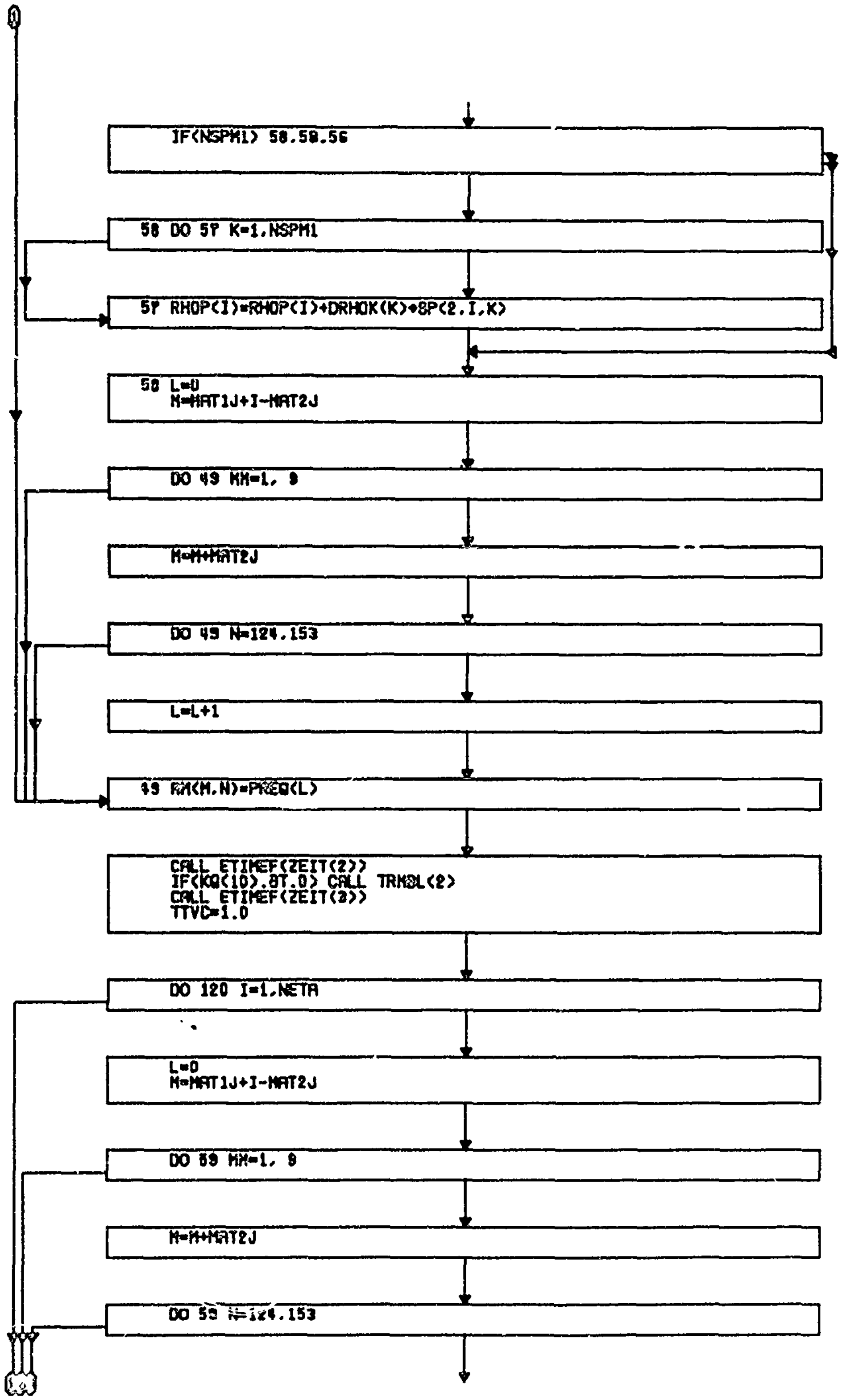

C B05B
SUBROUTINENONCER
EASE=AMIN1(EASE*2.,1.0)
IF(ITS-1) 11,5,11
5 EASE = .3333
SPNEW = 0.
BUMP = 1.0
IF(ITEM+IS-2) 3,3,2
2 IF(WDOT) 4,3,3
3 WDOT=-.12/C1
4 PIEASE=1.
ICORM = 1
CORMA = 1.E + 10
TFZ = 0.
IF (KRS(IS)) 8,8,7
7 KR(S)=KRS(IS)
8 DO 17 I=1,NETA
17 EPSA(I)=0.
IF(KR(S)-2) 11,10,9
9 FLUXJ(3,IS,IT)=-1.
10 ISP=IZ+1


KK=MAX0(1,KS(IS))
W(1) = FLUXJ(1,IS, IT)
W(2)=FLUXJ(2,IS,IT)
W(3)=FLUXJ(3,IS,IT)
L2=2*KK
L3=L2+1
IF(KR(3)-2) 11,11,16
16 HPB=HPYB(KK)
EMISC=EMIV(KK)
HCARB=HCHAR(KK)
DO 12 J=ISP,NSPEC
IF(MOA(J)-ASU(KK)) 12,13,12
13 IF(MOB(J)-BSU(KK)) 12,14,12
14 ISU=J
GO TO 11
12 CONTINUE
ISU=ISP
11 KIP=0
IX = 0
C--- EVALUATE COEFFICIENTS AND ERRORS FOR NONLINEAR EQUATIONS
C INITIALIZE AM MATRIX
DO 15 I=1,NNLEQ
ENL(I)=0.



1
DO 15 J=1,NNLEQ
15 AM(I,J) = 0.
C   EVAL. GROUPINGS WHICH CHANGE DURING ITERATION BUT ARE NOT F(ETA)
   40 C5 = 1. / ALPH
      DUM1 = ALPH * ALPH
      C6 = BETA * DUM1
      C7 = - UE(IS) / DUM1 * UE(IS) / 25036.5
      C8 = ALPHD * C5
      C9 = C4 - C8
      C30 = ALPH * DUEDGE
      UKAP=UEDGE
C----- EVAL COEFS. AM, AND ERRORS FOR EDGE BOUN CONDS AND ALPH CONSTRAINT
C   FIRST, COMPUTE UEDGE IF THERE IS AN ENTROPY LAYER
COMMENT-----PERFORM TABLE LOOKUP FOR UEDGE (WHICH IS A FUNCTION OF
COMMENT-----F(1,NETA),IS,AND IT), DIFFERENTIATE TO GET DUEDGE, AND
COMMENT-----DIFFERENTIATE AGAIN TO GET D2UEDG
C   NEXT, EVALUATE NONLINEAR ERRORS
   45 ENL(4)=-(ALPH*UEDGE-F(2,NETA))
      ENL(3)=-F(2,1)
IF(KR(10)-2) 41,41,42
41 ENL(2)=-(F(2,KAPPA)-CBAR*ALPH*UKAP)
AM(2,KAPPA+3)=1.
AM(2,1)=-CBAR*UKAP
GO TO 43
42 ENL(2)=-F(8,NETA)
CALL LIAD(-1,2,NETA+NETA-2,1.)
   43 AM(4,1)=UEDGE
      AM(4,MAT1J)=-1
      AM(3,4)=1.
C   FINALLY, EVAL CONTRIBUTIONS TO AM AND ERRORS FROM OTHER COEFFS
      CALL LIAD(-1,NETA+1,NETA-1,C30)
C----- START OF MAJOR DO LOOP FOR EVAL OF COEFFS AND ERRORS AT EACH ETA
      KQ(1)=2
      KQ(5)=0
      CALL ETIMEF(ZEIT(1))
DO 49 I=1,NETA
H(I)=G(1,I)+0.5*F(2,I)+C7*F(2,I)
HP=G(2,I)+F(2,I)*C7*F(3,I)
1


IF(KR(7)) 47,47,46
46 CALL STATE
GO TO 48
47 CALL EQUIL(KG,H(I),PE(IS,IT))
48 IF(I-1) 50,50,54
50 IF(NSPM1) 53,53,51
51 DO 52 K=1,NSPM1
DO 31 KK=1,NSP
31 DLPK(K,KK) = A(KK+2, K+2)
52 DTKW(K)= DTK(K)
DO 32 KK=1,NSP
32 DLPH(KK)= A(KK+2,1)
VLNKW=VLNK(ISU)
TCW=TC(ISU)
HCWAL = HH(ISU)/WTM(ISU)+1.0
53 DTHW=DTH
54 RHOP(I)=DRHOH+HP


IF(NSPM1) 58,58,56
56 DO 57 K=1,NSPM1
57 RHOP(I)=RHOP(I)+DRHOK(K)*SP(2,I,K)
58 L=0
M=MAT1J+I-MAT2J
DO 49 MM=1, 9
M=M+MAT2J
DO 49 N=124,153
L=L+1
49 RM(M,N)=PREQ(L)
CALL ETIMEF(ZEIT(2))
IF(KQ(10).GT.0) CALL TRNSL(2)
CALL ETIMEF(ZEIT(3))
TTVC=1.0
DO 120 I=1,NETA
L=0
M=MAT1J+I-MAT2J
DO 59 MM=1, 9
M=M+MAT2J
DO 59 N=124,153

```
      L=L+1
      PREQ(L)=AM(M,N)

   59 AM(M,N)=0.

C     TEST TO BYPASS COMMANDS THAT CANNOT BE PERFORMED AT ETA(1)

      IF (I - 1) 60,60,55

   55 CALL IMONE
      IF(KQ(9).NE.0) CALL TRANCR(3)
      IF(KQ(10).GT.0) CALL TRMBL(4)
C     COMPUTE STATIC ENTHALPY AND DETERMINE STATE OF GAS

   60 C10 = C7 + F(2,I)
      C13 = C7 + F(3,I)
      HP = G(2,I) + F(2,I) + C13
C---- EVAL GROUPINGS WHICH ARE USED AT I-1 AS WELL AS AT I
   75 CALL ICOEFF
      IF(KQ(9).NE.0) CALL TRANCR(2)
      IF(KQ(10).GT.0) CALL TRMBL(3)

      IF (I - 1) 100,80,100

C     DLPK,TCW,VLNKW,DLPH, AND Y1 NEEDED ONLY FOR CARBON PROBLEM

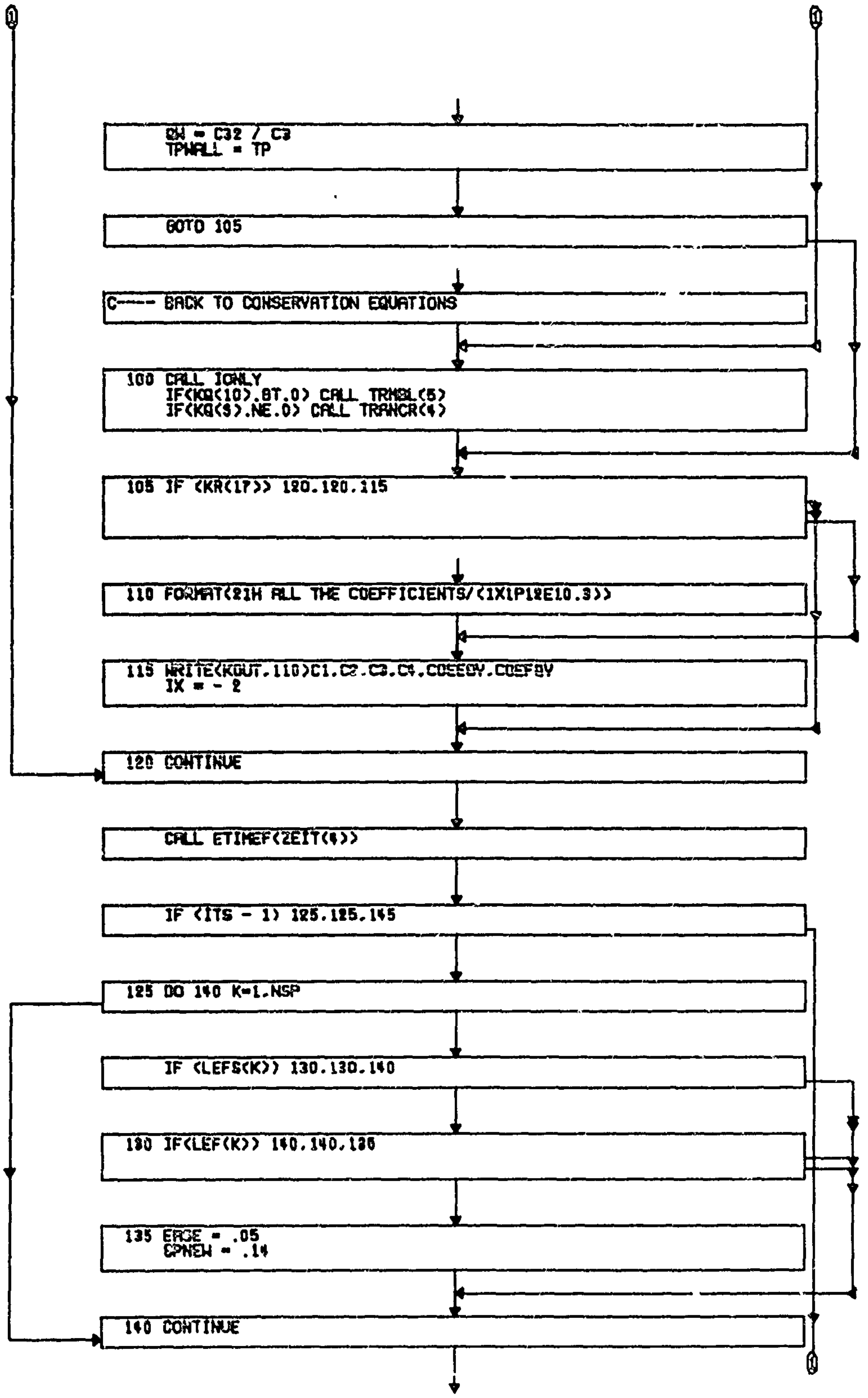
   80 IF (NSPM1) 95,95,85

   85 DO 90 K=1,NSPM1

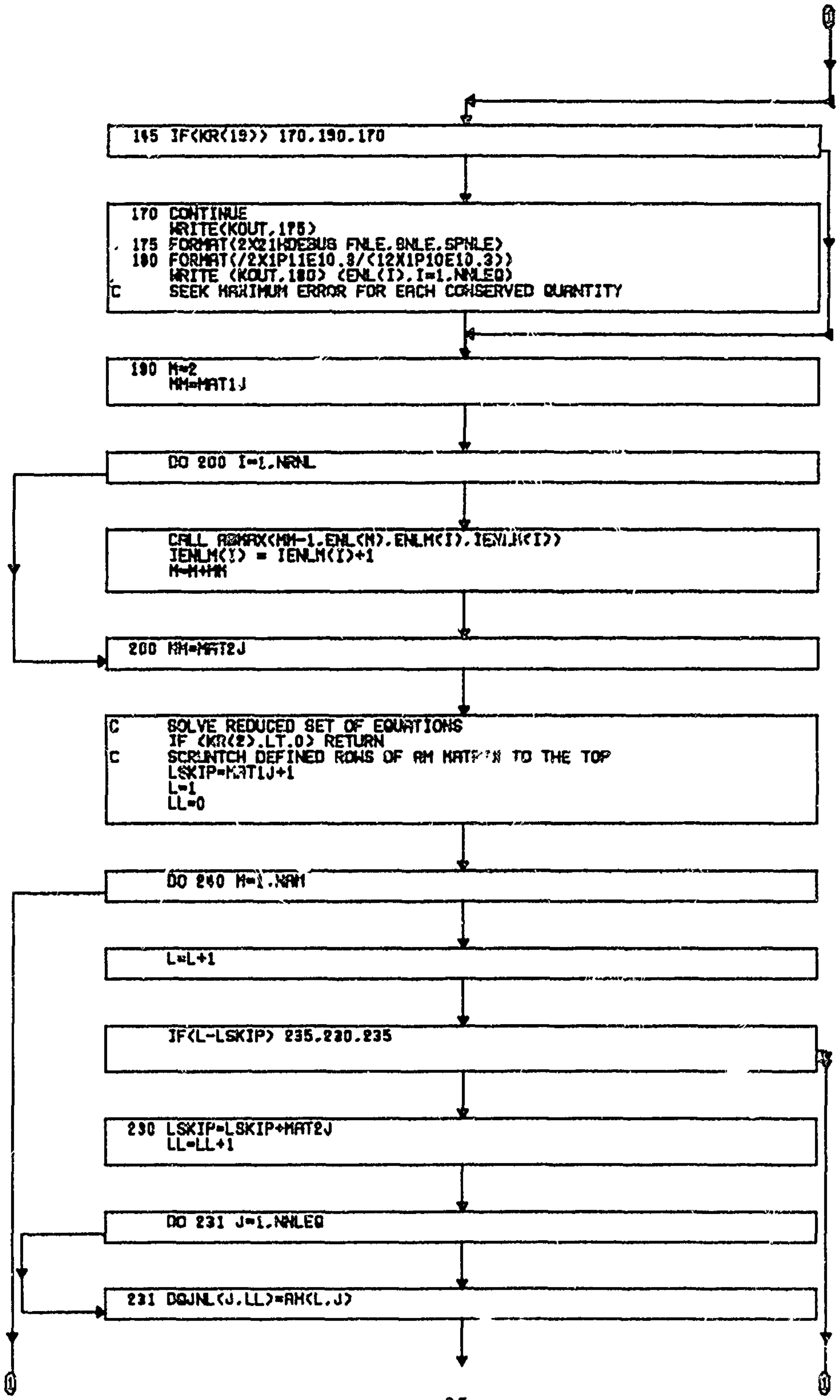
      WALLJ(K) = CK6(K)
      VJKW(K) = CK8(K) / C9

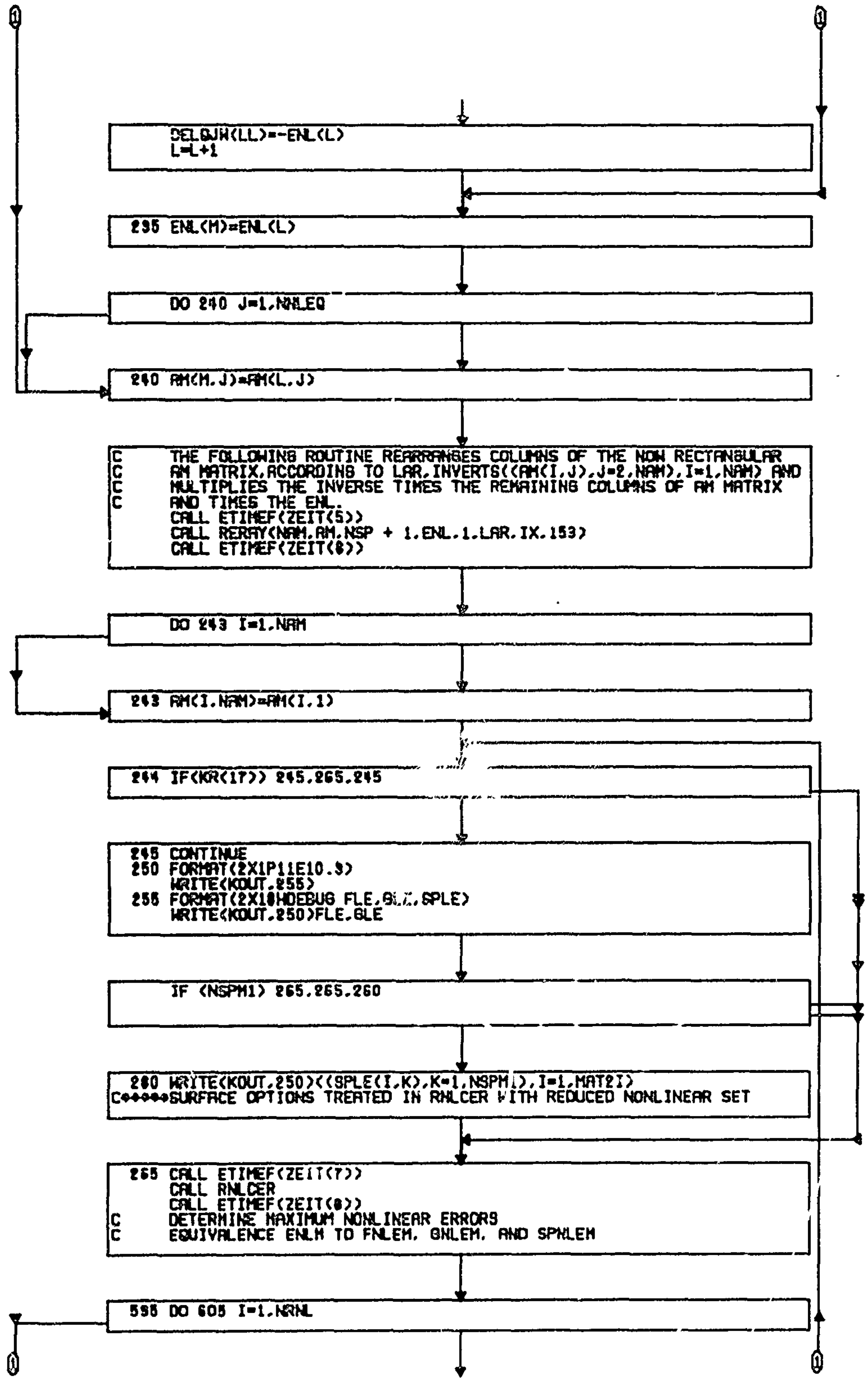
   90 CONTINUE

   95 WALLQ = C32
```



QW = C32 / C3
TPWALL = TP
GOTO 105
C---- BACK TO CONSERVATION EQUATIONS
100 CALL IONLY
IF(KQ(10).GT.0) CALL TRNSL(5)
IF(KQ(5).NE.0) CALL TRANCR(4)
105 IF (KR(17)) 120,120,115
110 FORMAT(21H ALL THE COEFFICIENTS/(1X1P12E10.3))
115 WRITE(KOUT,110)C1,C2,C3,C4,COSEOV,COEFBV
IX = - 2
120 CONTINUE
CALL ETIMEF(ZEIT(4))
IF (ITS - 1) 125,125,145
125 DO 140 K=1,NSP
IF (LEFS(K)) 130,130,140
130 IF(LEF(K)) 140,140,135
135 ERGE = .05
CPNEW = .14
140 CONTINUE


145 IF(KR(19)) 170,190,170
170 CONTINUE
WRITE(KOUT,175)
175 FORMAT(2X21HDEBUG FNLE,GNLE,SPNLE)
180 FORMAT(/2X1P11E10.3/(12X1P10E10.3))
WRITE (KOUT,180) (ENL(I),I=1,NNLEQ)
C SEEK MAXIMUM ERROR FOR EACH CONSERVED QUANTITY
190 M=2
MM=MAT1J
DO 200 I=1,NRNL
CALL AGMAX(MM-1,ENL(M),ENLM(I),IENLM(I))
IENLM(I) = IENLM(I)+1
M=M+MM
200 MM=MAT2J
C SOLVE REDUCED SET OF EQUATIONS
IF (KR(2).LT.0) RETURN
C SCRUNTCH DEFINED ROWS OF AM MATRIX TO THE TOP
LSKIP=MAT1J+1
L=1
LL=0
DO 240 M=1,NAM
L=L+1
IF(L-LSKIP) 235,230,235
230 LSKIP=LSKIP+MAT2J
LL=LL+1
DO 231 J=1,NNLEQ
231 DGJNL(J,LL)=AM(L,J)


DELGJH(LL)=-ENL(L)
L=L+1
235 ENL(M)=ENL(L)
DO 240 J=1,NNLEQ
240 AM(M.J)=AM(L.J)
C THE FOLLOWING ROUTINE REARRANGES COLUMNS OF THE NON RECTANGULAR
C AM MATRIX,ACCORDING TO LAR,INVERTS((AM(I,J),J=2,NAM),I=1,NAM) AND
C MULTIPLIES THE INVERSE TIMES THE REMAINING COLUMNS OF AM MATRIX
C AND TIMES THE ENL.
CALL ETIMEF(ZEIT(5))
CALL RERAY(NAM.AM.NSP + 1.ENL.1.LAR.IX.153)
CALL ETIMEF(ZEIT(6))
DO 243 I=1.NAM
243 AM(I.NAM)=AM(I.1)
244 IF(KR(17)) 245.265.245
245 CONTINUE
250 FORMAT(2X1P11E10.3)
WRITE(KOUT.255)
255 FORMAT(2X18HDEBUG FLE,GLE,SPLE)
WRITE(KOUT.250)FLE.GLE
IF (NSPM1) 265.265.260
260 WRITE(KOUT,250)((SPLE(I,K),K=1,NSPM1),I=1,MAT2I)
C*****SURFACE OPTIONS TREATED IN RNLCER WITH REDUCED NONLINEAR SET
265 CALL ETIMEF(ZEIT(7))
CALL RNLCER
CALL ETIMEF(ZEIT(8))
C DETERMINE MAXIMUM NONLINEAR ERRORS
C EQUIVALENCE ENLM TO FNLEM, GNLEM, AND SPNLEM
595 DO 605 I=1.NRNL

```
      IF(ABS(ENLM(I))-ABS(DRNL(I))) 600,605,605

  600 ENLM(I) = DRNL(I)
      IENLM(I) = 1

  605 CONTINUE

      ENLM(1)=ENLM(1)*10.
      ENLM(2)=ENLM(2)/1000.
      CALL ABMAX(NRNL,ENLM,ENLMM,INLMM)
      ENLMM=ENLMM/10.
      ENLM(1)=ENLM(1)/10.
      ENLM(2)=ENLM(2)*1000.
      ELMM = ABS(ELMM)
      BIP = KIP
      ENLMM = ABS(ENLMM) + 3. * BIP
C     EVALUATE NONLINEAR CORRECTIONS FROM THE REDUCED SET

      DO 615 I=1,NAM

      L = LAR(I)
      DVNL(L) = ENL(I)

      DO 615 K=1,NRNL

      J = K + NAM

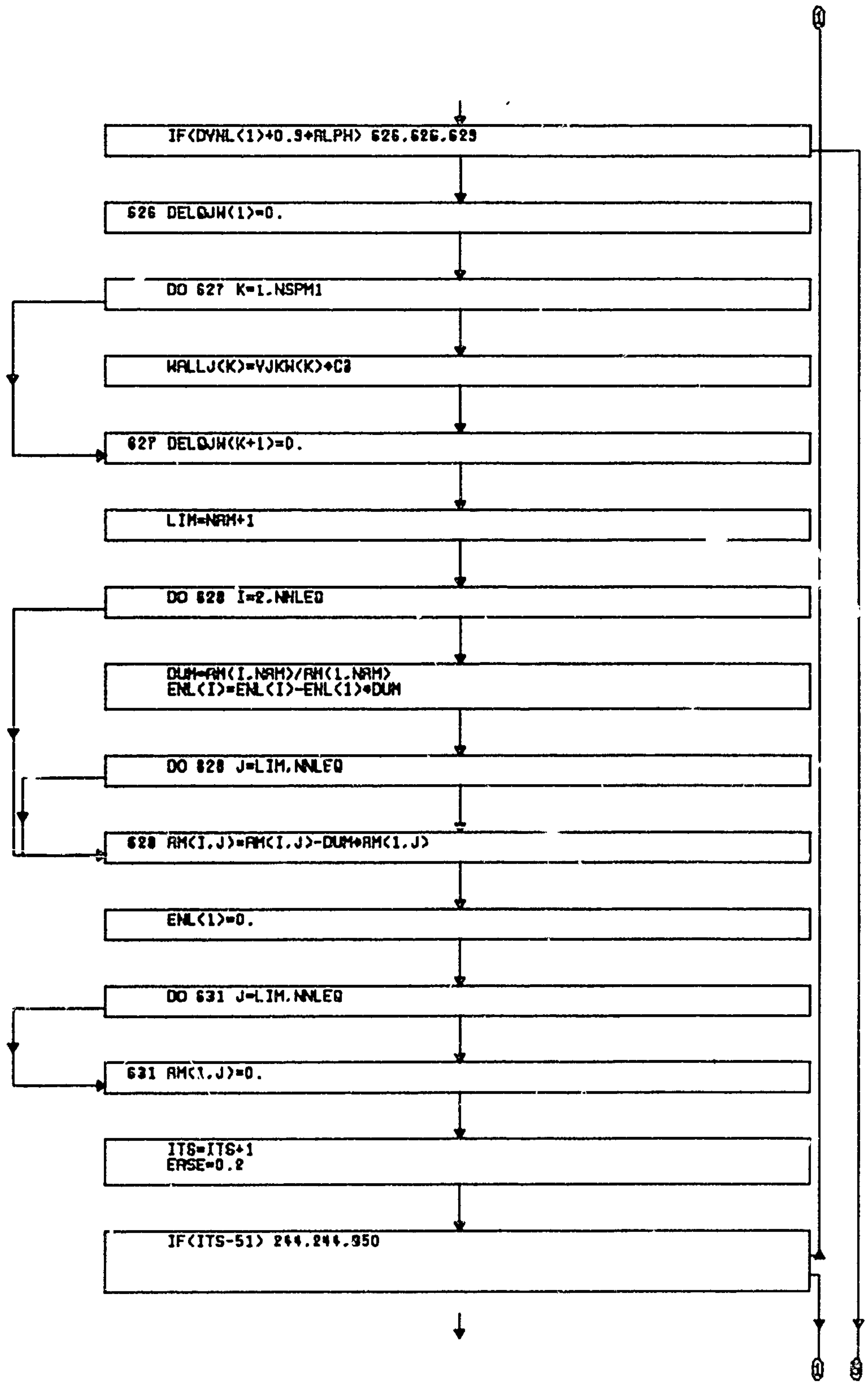
  615 DVNL(L) = DVNL(L) - DRNL(K) * AM(I,J)

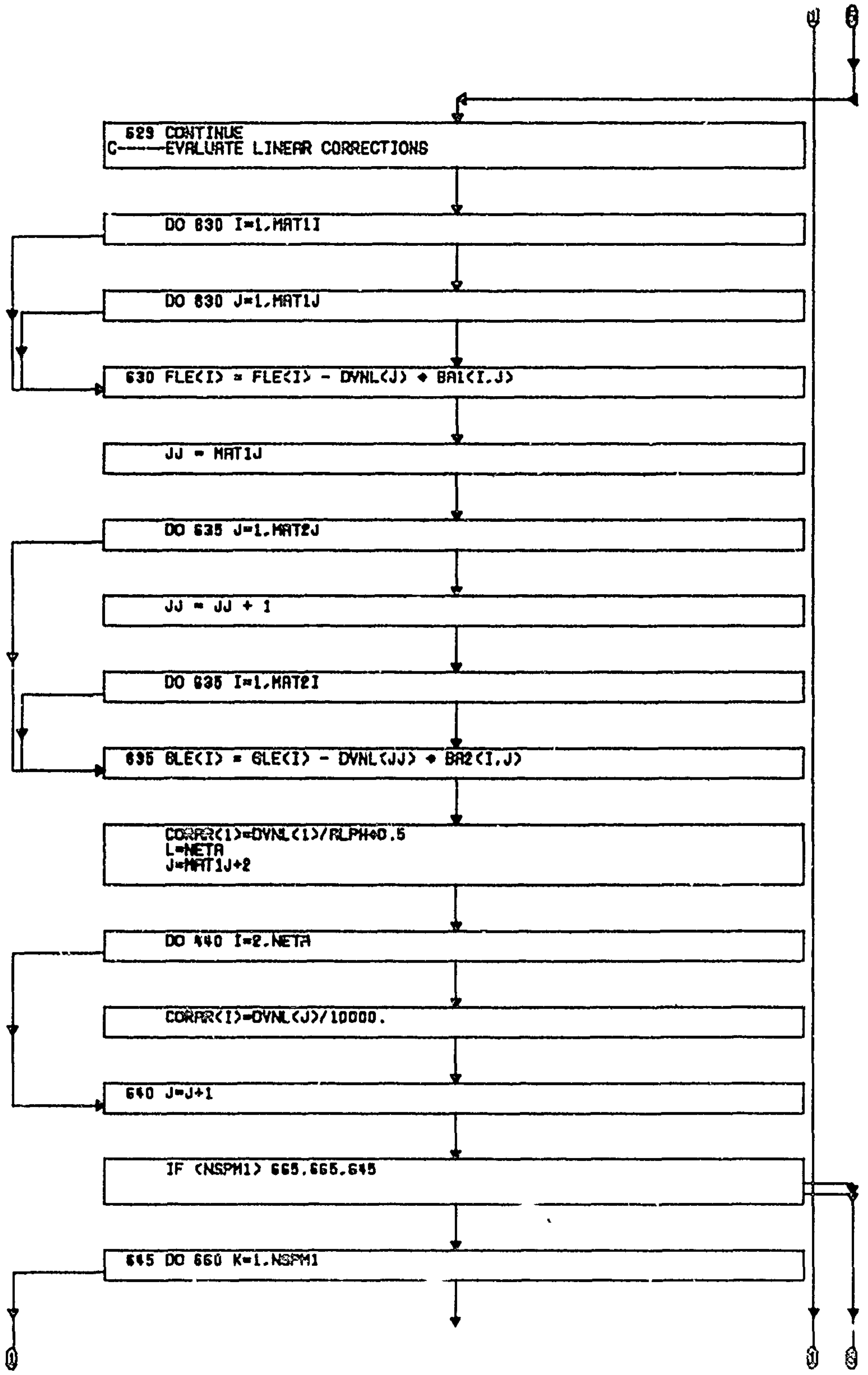
      DO 620 K=1,NRNL

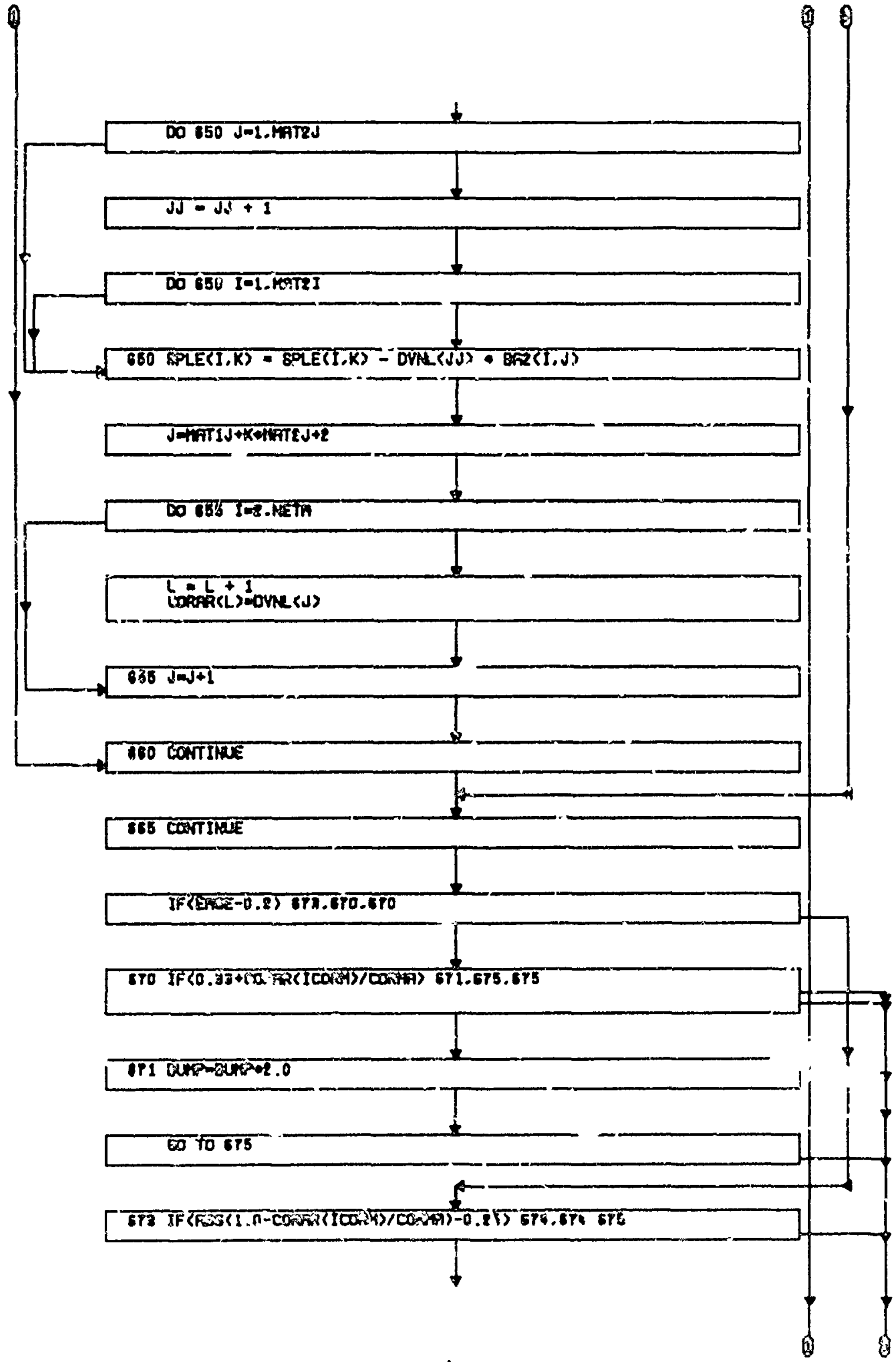
      I = NAM + K
      J = LAR(I)

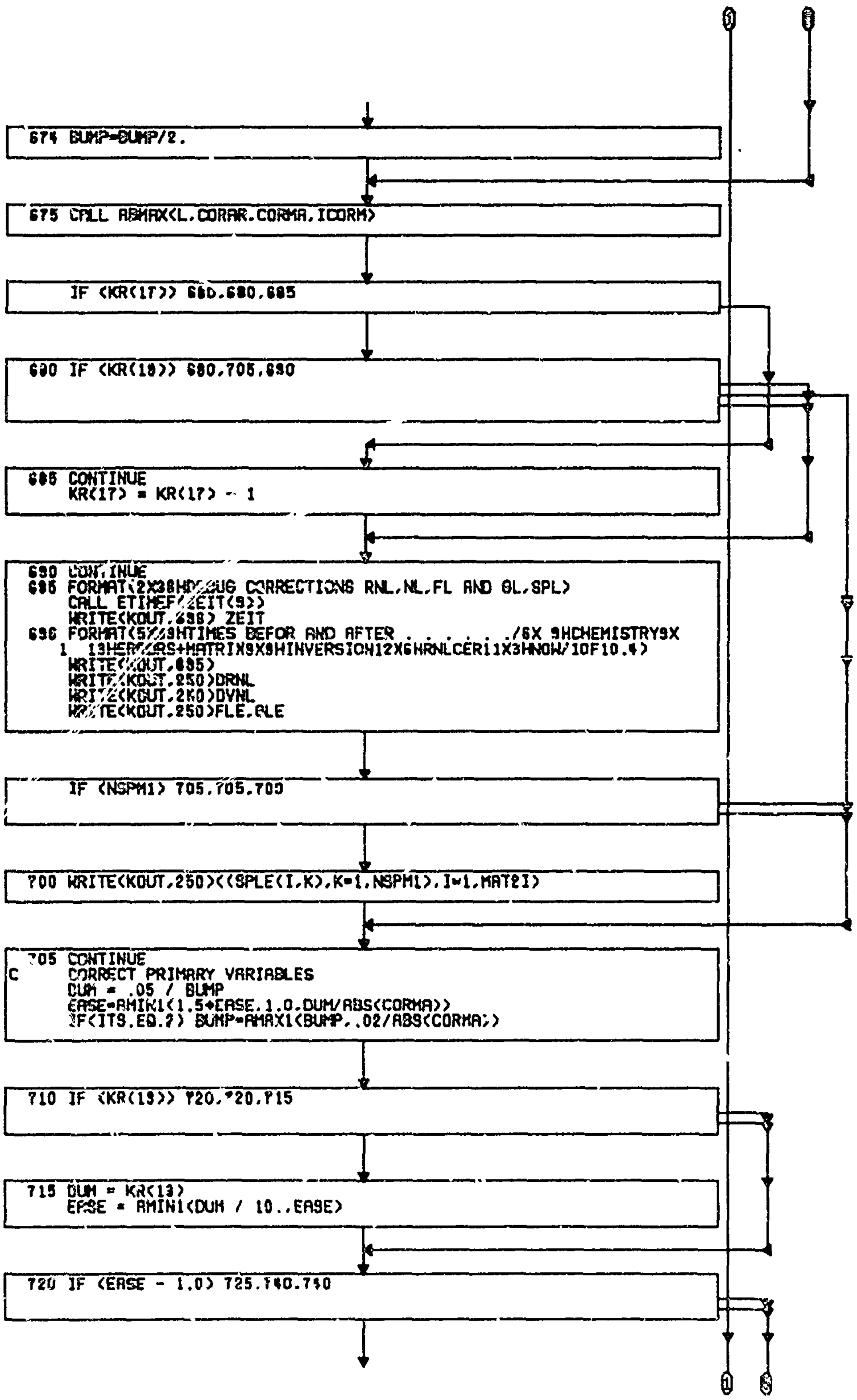
  620 DVNL(J) = DR .(K)

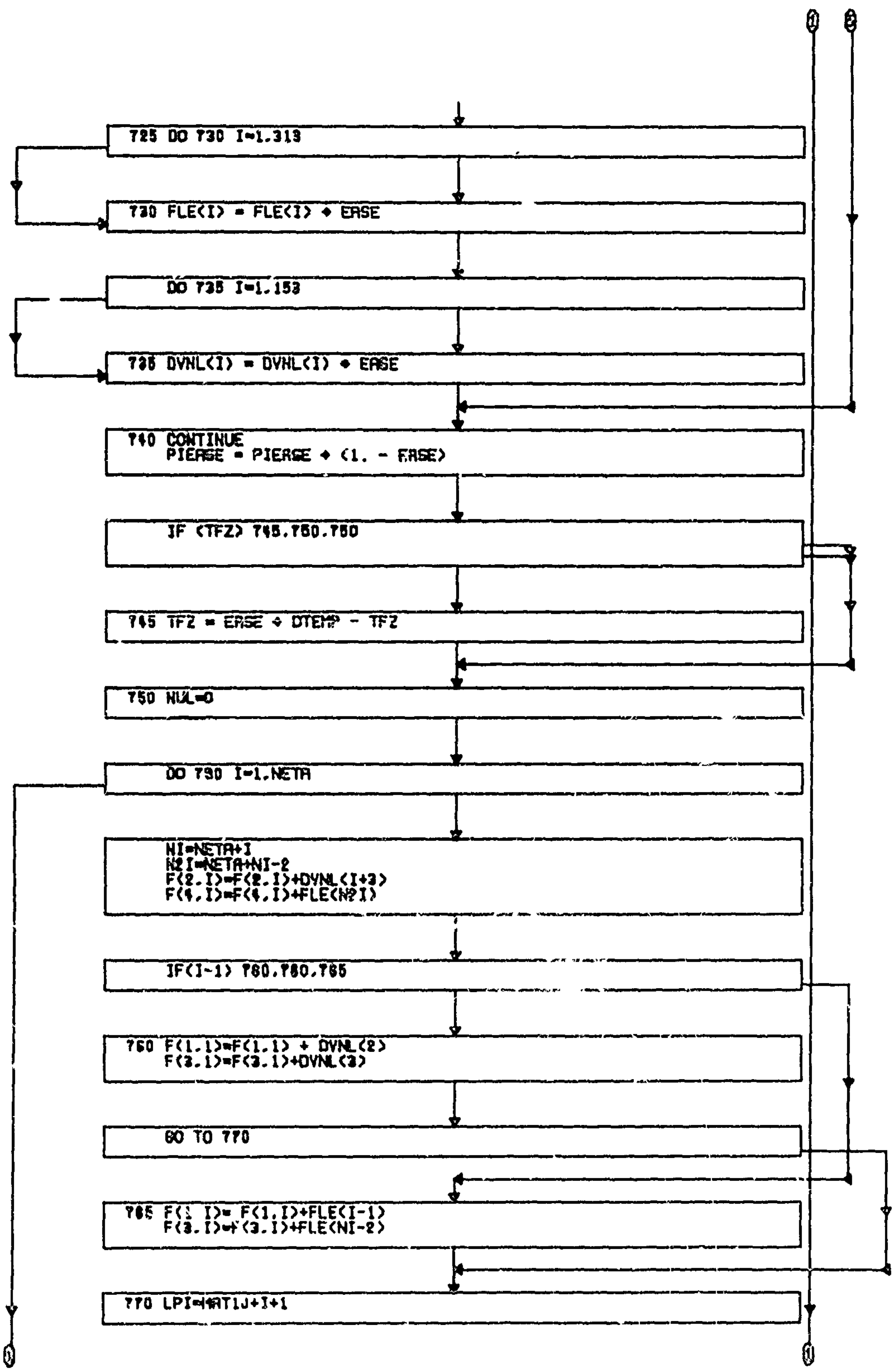
C-----RECYCLE IF ALPH WANTS TO GO NEGATIVE
```

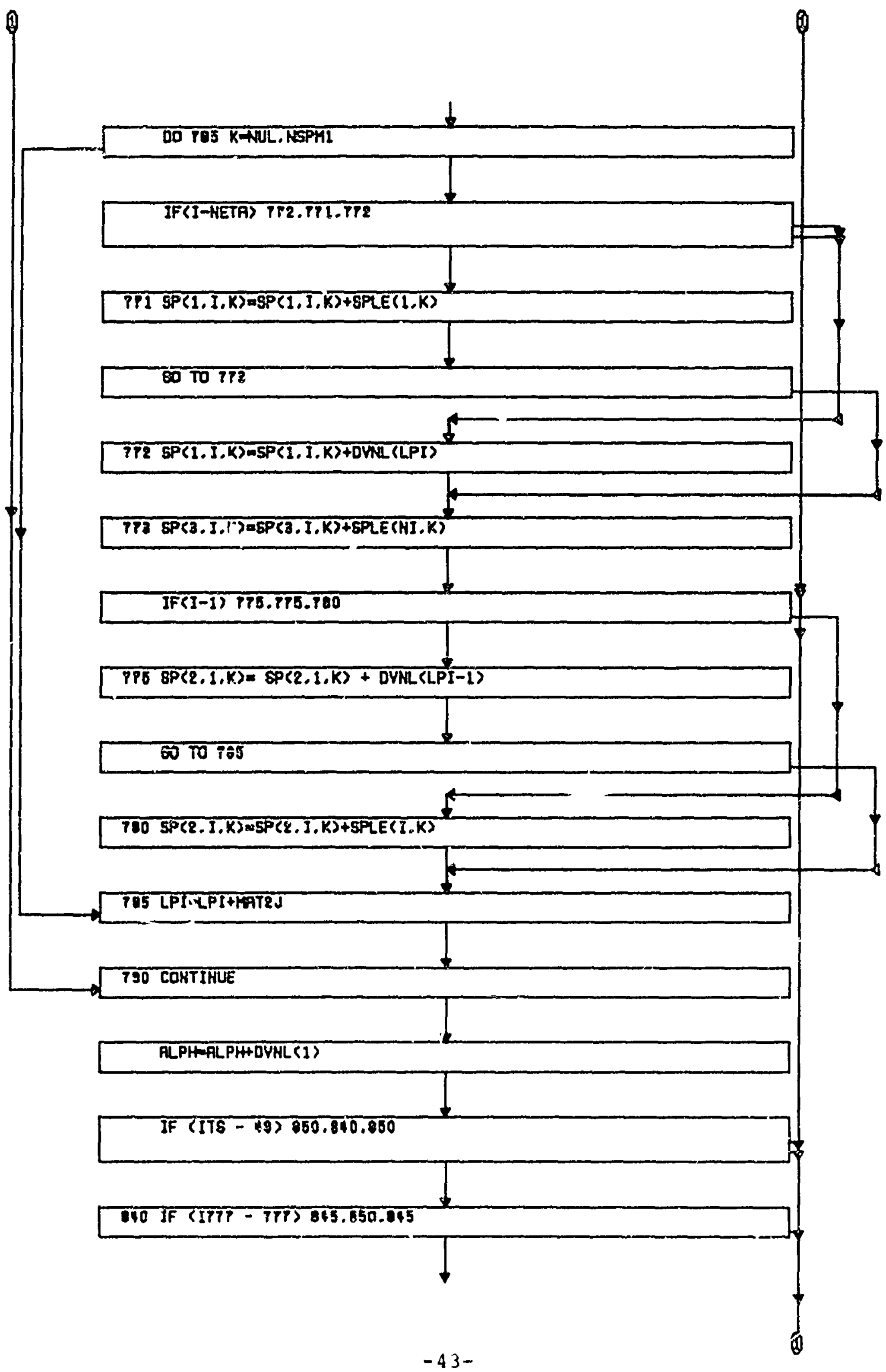

IF(DVNL(1)+0.9*ALPH) 626,626,629
626 DELQJH(1)=0.
DO 627 K=1,NSPM1
WALLJ(K)=VJKH(K)*C3
627 DELQJH(K+1)=0.
LIM=NAM+1
DO 628 I=2,NNLEQ
DUM=AM(I,NAM)/AM(1,NAM)
ENL(I)=ENL(I)-ENL(1)*DUM
DO 628 J=LIM,NNLEQ
628 AM(I,J)=AM(I,J)-DUM*AM(1,J)
ENL(1)=0.
DO 631 J=LIM,NNLEQ
631 AM(1,J)=0.
ITS=ITS+1
ERSE=0.2
IF(ITS-51) 244,244,950


629 CONTINUE
C-----EVALUATE LINEAR CORRECTIONS
DO 630 I=1,MAT1I
DO 630 J=1,MAT1J
630 FLE(I) = FLE(I) - DVNL(J) * BA1(I,J)
JJ = MAT1J
DO 635 J=1,MAT2J
JJ = JJ + 1
DO 635 I=1,MAT2I
635 GLE(I) = GLE(I) - DVNL(JJ) * BA2(I,J)
CORAR(1)=DVNL(1)/ALPH+0.5
L=NETA
J=MAT1J+2
DO 640 I=2,NETA
CORAR(I)=DVNL(J)/10000.
640 J=J+1
IF (NSPM1) 665,665,645
645 DO 660 K=1,NSPM1


DO 650 J=1.MAT2J
JJ = JJ + 1
DO 650 I=1.MAT2I
650 SPLE(I.K) = SPLE(I.K) - DVNL(JJ) * BA2(I.J)
J=MAT1J+K*MAT2J+2
DO 655 I=2.NETA
L = L + 1
CORAR(L)=DVNL(J)
655 J=J+1
660 CONTINUE
665 CONTINUE
IF(EAGE-0.2) 673.670.670
670 IF(0.33+CORAR(ICORM)/CORMA) 671.675.675
671 DUMP=DUMP+2.0
GO TO 675
673 IF(ABS(1.0-CORAR(ICORM)/CORMA)-0.25) 674.674 675


1
8
674 BUMP=BUMP/2.
675 CALL ABMAX(L.CORAR.CORMA.ICORM)
IF (KR(17)) 680.680.685
680 IF (KR(18)) 690.705.690
685 CONTINUE
KR(17) = KR(17) - 1
690 CONTINUE
695 FORMAT(2X38HDEBUG CORRECTIONS RNL,NL,FL AND GL,SPL)
CALL ETIMEF(ZEIT(9))
WRITE(KOUT.698) ZEIT
698 FORMAT(5X/9HTIMES BEFOR AND AFTER . . . ./6X 9HCHEMISTRY9X
1 13HERRORS+MATRIX9X9HINVERSION12X6HRNLCER11X3HNOW/10F10.4)
WRITE(KOUT,695)
WRITE(KOUT.250)DRNL
WRITE(KOUT.250)DVNL
WRITE(KOUT.250)FLE.GLE
IF (NSPM1) 705.705.700
700 WRITE(KOUT,250)((SPLE(I,K),K=1,NSPM1),I=1,MAT2I)
705 CONTINUE
C CORRECT PRIMARY VARIABLES
DUM = .05 / BUMP
EASE=AMIN1(1.5*EASE.1.0.DUM/ABS(CORMA))
IF(ITS.EQ.2) BUMP=AMAX1(BUMP,.02/ABS(CORMA))
710 IF (KR(13)) 720.720.715
715 DUM = KR(13)
EASE = AMIN1(DUM / 10..EASE)
720 IF (EASE - 1.0) 725.740.740
1
8


725 DO 730 I=1,313
730 FLE(I) = FLE(I) + EASE
DO 735 I=1,153
735 DVNL(I) = DVNL(I) + EASE
740 CONTINUE
PIEASE = PIEASE + (1. - EASE)
IF (TFZ) 745,750,750
745 TFZ = EASE + DTEMP - TFZ
750 NUL=0
DO 790 I=1,NETA
NI=NETA+I
N2I=NETA+NI-2
F(2,I)=F(2,I)+DVNL(I+3)
F(4,I)=F(4,I)+FLE(N2I)
IF(I-1) 760,760,765
760 F(1,1)=F(1,1) + DVNL(2)
F(3,1)=F(3,1)+DVNL(3)
GO TO 770
765 F(1,I)= F(1,I)+FLE(I-1)
F(3,I)=F(3,I)+FLE(NI-2)
770 LPI=MAT1J+I+1


DO 785 K=NUL,NSPM1
IF(I-NETA) 772,771,772
771 SP(1,I,K)=SP(1,I,K)+SPLE(1,K)
GO TO 773
772 SP(1,I,K)=SP(1,I,K)+DVNL(LPI)
773 SP(3,I,K)=SP(3,I,K)+SPLE(NI,K)
IF(I-1) 775,775,780
775 SP(2,I,K)= SP(2,I,K) + DVNL(LPI-1)
GO TO 785
780 SP(2,I,K)=SP(2,I,K)+SPLE(I,K)
785 LPI=LPI+MAT2J
790 CONTINUE
ALPH=ALPH+DVNL(1)
IF (ITS - 49) 850,840,850
840 IF (I777 - 777) 845,850,845

1

```
845 ITYP = TYP
    ITS = 30

850 CONTINUE
    IF(KQ(10).GT.-1) RETURN
    RETHMO=-C3*RHOE(IS)*UE(IS)*(F(1,NETA)-F(1,1)-XM(5)/ALPH)
    IF(RETHMO.GT.RETR) KQ(10)=-10
    IF(RETHMO.LT.RETR) KQ(10)=-1

    RETURN

    END
```

5. SUBROUTINE RNLCER - B05C

a. Function

Further reduces nonlinear equations to reduced nonlinear set of wall variables. Introduces wall boundary conditions and solves for new values of this set. Called by NONCER. Calls RERAY.

b. Listing

```
C      B05C
       SUBROUTINE RNLCER
       DIMENSIONDQJRNL( 71,1)                                            B05C 003
       DIMENSIONDELQJW(1) ,DQJNL(153,1) ,WALLQJ(1)                       B05C 004
       COMMON/BLACOM/  HOA( 71),  MOR( 71),NSPEC,FR( 71,15),W(3),LEF(10) B05C   5
      1,LEFS(10),PIEASE,LEFW(10)                                         B05C   6
       COMMON/BUMCOM/     BUMP,CORMA,FASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IXB05C   7
       COMMON/CRACOM/HCARB,EMIS,STFF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMISTB05C   8
      1,HPG,ASU(3),BSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(40),ISU            B05C   9
       COMMON/EDGCOM/                 PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B05C  A9
      1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90   B05C  B9
      2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                    B05C  C9
       COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,    B05C  10
      1EPSA(15),EPS1,EL(15),DPI(15,2),DLI(153),DEPS(153),DEPC,TREF,RETR  B05C  11
       COMMON/EQPCOM/  RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B05C  12
      1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B05C  13
      2 KAT(10),IR(10),IZ,KZ(10),LAMI( 71),P,Z,TK(10, 7),VN( 71),        B05C  14
      3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),YYY( 71),YW( 71),GG( 71)B05C  15
      4 ,TQ(10, 7),EPOVRK,SIGMA,BASMOL                                   B05C  16
       COMMON/EQTCOM/SIP,HIP,EEL,EENL,FLIQ,CPF,IRE,IER,AA,IITS,IN,IL,IIT,B05C  17
      1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,BX,ISP2,ISPQ,   B05C  18
      2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HHG, B05C  19
      3 CCPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),BB(16),    B05C  20
      4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B05C  21
      5 CP( 71),HH( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),       B05C  22
      6 RC(10),BLNK(10),BY(10),IBC(10),BE(10),JZ( 4)                     B05C  23
       COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM     B05C  24
      1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)     B05C  25
      2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)      B05C  26
      3,FNLEM,GNLEM,SPNLEM( 8),            ENLMM,IFNLM,IGNLM,ISPNLM( 8)  B05C  27
      4,MENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)              B05C  28
       COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)      B05C  29
      1,LAR(153),BA1(43,18),BA2(30,15)                                   B05C  30
       COMMON/FLXCOM/DELQW,DELJW( 8),DQNL(153),DJNL(153, 8),WALLQ        B05C  31
      1,WALLJ( 8),QW,VJKW( 9),TPWALL                                     B05C  32
       COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8B05C  33
      1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B05C  34
      2,C3M(40),BETAM(40)                                                B05C  35
       COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB05C  36
      1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B05C  37
      2,R(8),       MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B05C  38
      3,KAUXO,JTIME,JSPEC,MD(3)                                          B05C  39
       COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                          B05C  40
      1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)               B05C  41
       COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B05C  42
      1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B05C  43
      2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                            B05C  44
       COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)   B05C  45
      1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB05C  46
      2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B05C  47
      3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)   B05C  48
      4,DPHIKK( 8, 8),       DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL  B05C  49
      5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B05C  50
      6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B05C  51
       COMMON/TEMCOM/SPDUM( 8),DER(40),DUMM1(15),SLOPE(15),REDUK(15)     B05C  52
      1,SDUM1(40),SDUM2(40),FWDUM(40),XICON(40),FWCON(40),FWINIT( 1)     B05C  53
      2,YIINIT( 1),DUDS( 40)                                             B05C  54
       COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B05C  55
```

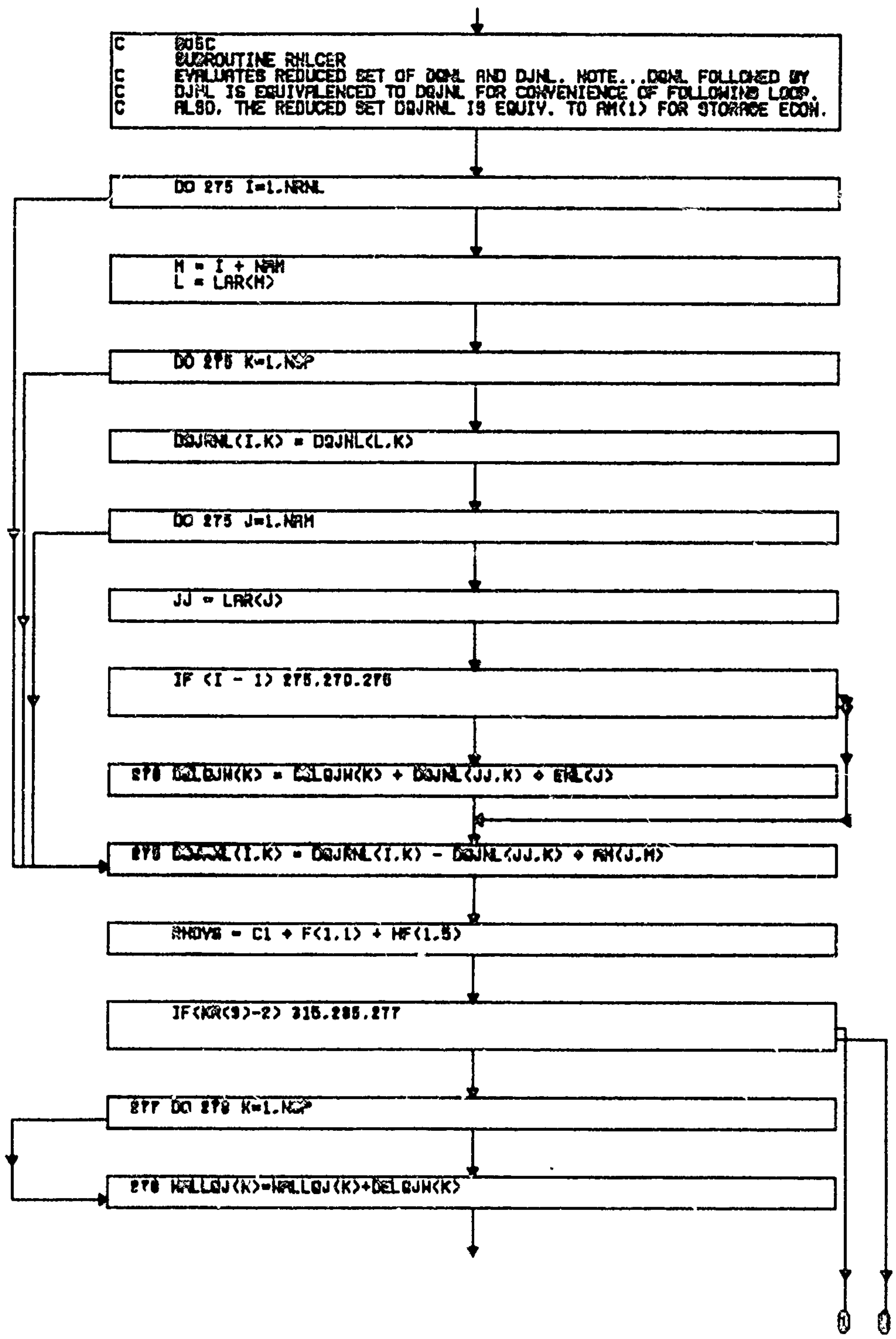
```
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         B05C  56
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      B05C  57
      EQUIVALENCE(DELQW,DELQJW),(DQNL,DQJNL),(WALLQ,WALLQJ)             B05A0380
      DIMENSIONCORAR(1)                                                 B05A0470
      EQUIVALENCE(CORAR(1),AM(1))                                       B05A0480
      EQUIVALENCE(AM,DQJRNL)                                            B05A0490
C     EVALUATES REDUCED SET OF DQNL AND DJNL. NOTE...DQNL FOLLOWED BY   B05A2390
C     DJNL IS EQUIVALENCED TO DQJNL FOR CONVENIENCE OF FOLLOWING LOOP.  B05A2400
C     ALSO, THE REDUCED SET DQJRNL IS EQUIV. TO AM(1) FOR STORAGE ECON. B05A2410
      DO 275 I=1,NRNL                                                   B05A2420
      M = I + JAM                                                       B05A2430
      L = LAR(M)                                                        B05A2440
      DO 275 K=1,NSP                                                    B05A2450
      DQJRNL(I,K) = DQJNL(L,K)                                          B05A2460
      DO 275 J=1,NAM                                                    B05A2470
      JJ = LAR(J)                                                       B05A2480
      IF (I - 1) 275,270,275                                            B05A2490
  270 DELQJW(K) = DELQJW(K) + DQJNL(JJ,K) * ENL(J)                      B05A2500
  275 DQJRNL(I,K) = DQJRNL(I,K) - DQJNL(JJ,K) * AM(J,M)                 B05A2510
      RHOVS = C1 * F(1,1) + HF(1,5)                                     B05A2520
      IF(KR(9)-2) 315,285,277                                               *NEW
  277 DO 278 K=1,NSP                                                        *NEW
  278 WALLQJ(K)=WALLQJ(K)+DELQJW(K)                                         *NEW
      GO TO 315                                                             *NEW
  285 DO 290 L=1,3                                                  B05A2550**-1
  290 W(L) = FLUXJ(L,IS,IT)                                             B05A2560
C     PREPARE DQJRNL AND WALLQJ FOR SURFACE MASS BALANCE                B05A2570
  295 WSUM = W(1) + W(2) + W(3)                                         B05A2580
      DO 310 K=2,NSP                                                    B05A2590
      WALLJ(K - 1) = WALLJ(K - 1) + DELQJW(K)                           B05A2600
      DQJRNL(1,K) = DQJRNL(1,K) / C1                                    B05A2610
      WALLJ(K - 1) = WALLJ(K - 1) - DQJRNL(1,K) * RHOVS - DQJRNL(2,K) * B05A2670
     1G(1,1)                                                            B05A2680
      DO 310 KK=3,NRNL                                                  B05A2690
  310 WALLJ(K - 1) = WALLJ(K - 1) - DQJRNL(KK,K) * SP(1,1,KK - 2)       B05A2700
  315 IF (KR(16) - 1) 345,340,320                                       B05A2710
  320 IF (KR(17)) 340,340,335                                           B05A2720
  325 FORMAT(52H  DEBUG DQJRNL(NRNL,NSP) BY ROWS, DELQW(5),WALLQJ(5)/   B05A2730
     1 (8X1P10E10.3))                                                   B05A2740
  330 FORMAT(35H  DEBUG DQJNL(NNLEQ,NSP) ROW BY ROW /(8X1P10E10.3))     B05A2750
  335 WRITE(KOUT,330)((DQJNL(I,K),K=1,NSP),I=1,NNLEQ)                   B05A2760
  340 WRITE(KOUT,325)((DQJRNL(I,K),K=1,NSP),I=1,NRNL),DELQW,DELJW,WALLQ,B05A2770
     1WALLJ                                                             B05A2780
      IX = - 2                                                          B05A2790
  345 CONTINUE                                                          B05A2800
      IF(KIP) 346,346,375
  346 IF(KR(9)-2) 347,355,395
  347 DRNL(1)=FW(IS,IT)-F(1,1)
      DRNL(2)=0.
      IF(NSPM1) 350,350,348
  348 DO 349 K=1,NSPM1
      DRNL(K+2)=SPW(K,IS,IT)-SP(1,1,K)
  349 DRNL(2)=DRNL(2)+DRNL(K+2)*DTKW(K)
  350 IF(KR(11)) 351,351,352
  351 DRNL(2)=(TW(IS,IT)-T(1)-DRNL(2))/DTHW
      GO TO 595
  352 DRNL(2)=HW(IS,IT)-G(1,1)
      GO TO 595
  355 IF (KR(11) - 1) 375,365,360                                       B05A2830
  360 IF (KR(11) - 3) 370,375,370                                       B05A2840
```

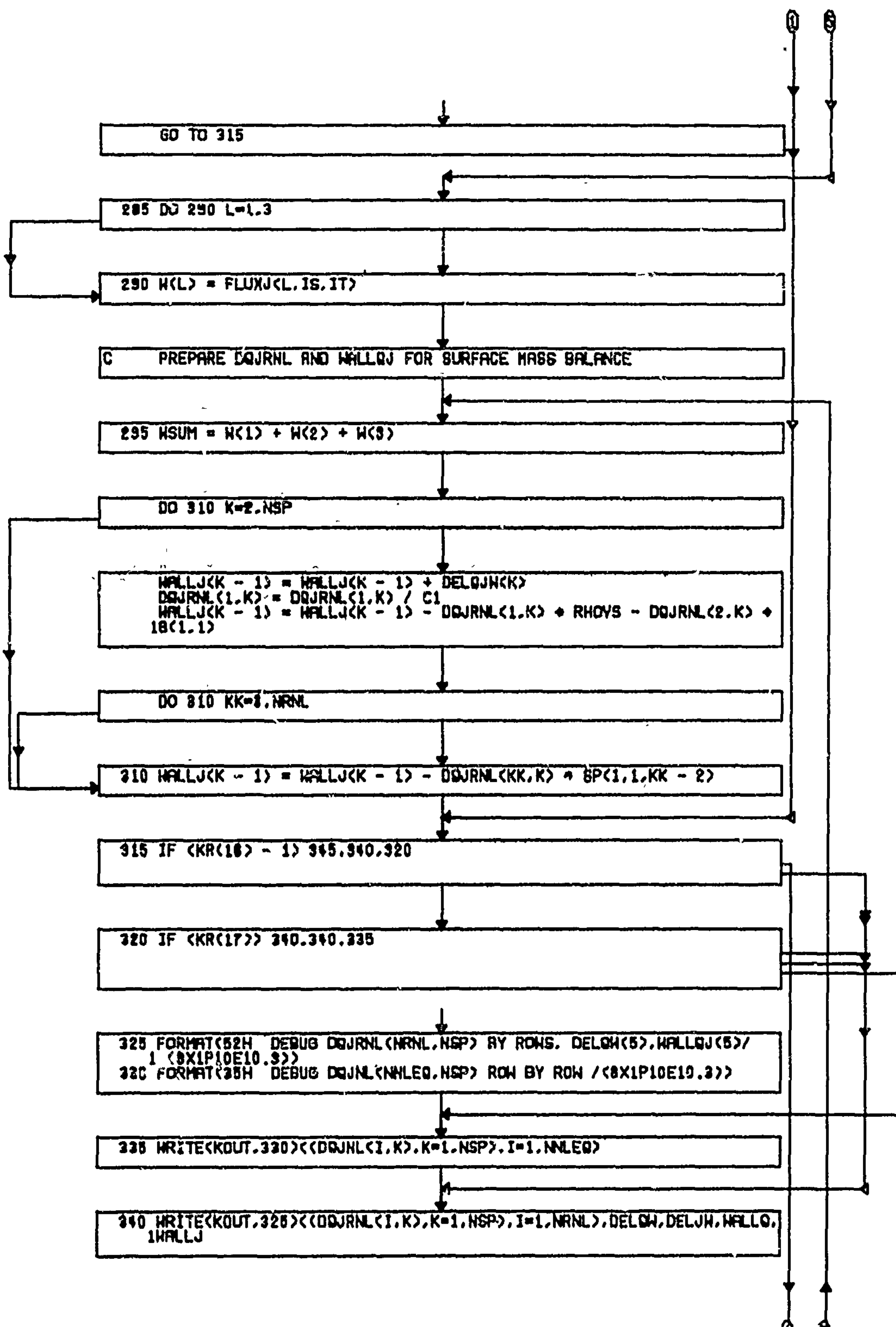
```
  365 KQ(1) = 2                                                         B05A2850
      DRNL(2)=HW(IS,IT)-G(1,1)
      HIP=(G(1,1)+EASE*(HW(IS,IT)-G(1,1)))/1.8
      GO TO 380
  370 KQ(1)=1
      IF(T(1)-1000.) 374,374,372
  372 IF (EASE-SPNEW) 374,374,380
  374 TW(IS,IT)=AMAX1(T(1),1500.)
  375 T(1)=T(1)+EASE*(TW(IS,IT)-T(1))
      KIP=MAX0(KIP-1,0)
  376 KQ(1)=0
  380 KQ(6) = 2                                                         B05A2910
      SPNEW=0.
      KQ(4) = 0                                                         B05A2920
      IF (KR(7))385,385,390
  385 CALL EQUIL(KQ,0.,PE(IS,IT))                                       B05A2930
  390 KQ(6) = 0                                                         B05A2940
      FW(IS,IT) = (RHOVW(IS,IT) - HF(1,5)) / C1                         B05A2950
      IF(KR(11)-1) 391,392,391
  391 DRNL(2)=(HW(IS,IT)-G(1,1))/EASE
  392 DRNL(1)=FW(IS,IT)-F(1,1)
      IF(NSPM1) 595,595,393
  393 DO 394 K=1,NSPM1
  394 DRNL(K+2)=(SPW(K,IS,IT)-SP(1,1,K))/EASE
      GO TO 595
C     KIP=1 IF USING ASSIGNED TEMPERATURE ON ENERGY BALANCE FOR TEFLON  B05A2970
  395 KIP = 0                                                           B05A2980
      W(3)=RHOVS-W(2)
      IF (IABS(KR(9) - 4) - 1) 460,450,400                              B05A3040
  400 HMAT = HTEF
      EMIS = EMIST
      IF (ITS - 1) 465,465,405                                          B05A3070
  405 IF (TFZ) 465,465,410                                              B05A3080
  410 IF (ABS(T(1) - TFZ) - 10.) 465,435,435                            B05A3090
  415 IF (DTEMP * DUM2) 440,440,420                                     B05A3100
  420 IF (DUM1 * 20. + WDOT) 425,425,430                                B05A3110
  425 TFZ = T(1) - 50. / DTEMP * ATEMP                                  B05A3120
      BUMP = 1.                                                         B05A3130
      GOTO 435                                                          B05A3140
  430 TFZ = T(1)
  435 TW(IS,IT) = TFZ                                                   B05A3160
      GOTO 445                                                          B05A3170
  440 TW(IS,IT) = T(1) + 50. / DTEMP * ATEMP                            B05A3180
      BUMP = 1.                                                         B05A3190
  445 KIP = 1                                                           B05A3200
  450 DRNL(2) = TW(IS,IT) - T(1)                                        B05A3210
      AM(2,4) = 0.                                                      B05A3220
      AM(2,5) = DTHW                                                    B05A3230
      DO 455 K=1,NSPM1                                                  B05A3240
  455 AM(2,K + 5) = DTKW(K)                                             B05A3250
      IF (KR(9) - 4) 475,475,485                                        B05A3260
  460 HMAT=HCARB
      EMIS=EMISC
  465 TFZ = 0.
      DUM1 = STEF * EMIS * (T(1)) * * 3. * C3                           B05A3330
      DRNL(2) = - WALLG + RHOVS * (HMAT - G(1,1)) - DUM1 * T(1) + RADS(
     1IS)*C3+W(2)*(HPG-HMAT)
      DUM2 = DRNL(2)                                                    B05A3360
      AM(2,4) = DQJRNL(1,1) + C1 * (G(1,1) - HMAT)
      DUM1 = DUM1 * 4.                                                  B05A3380
```

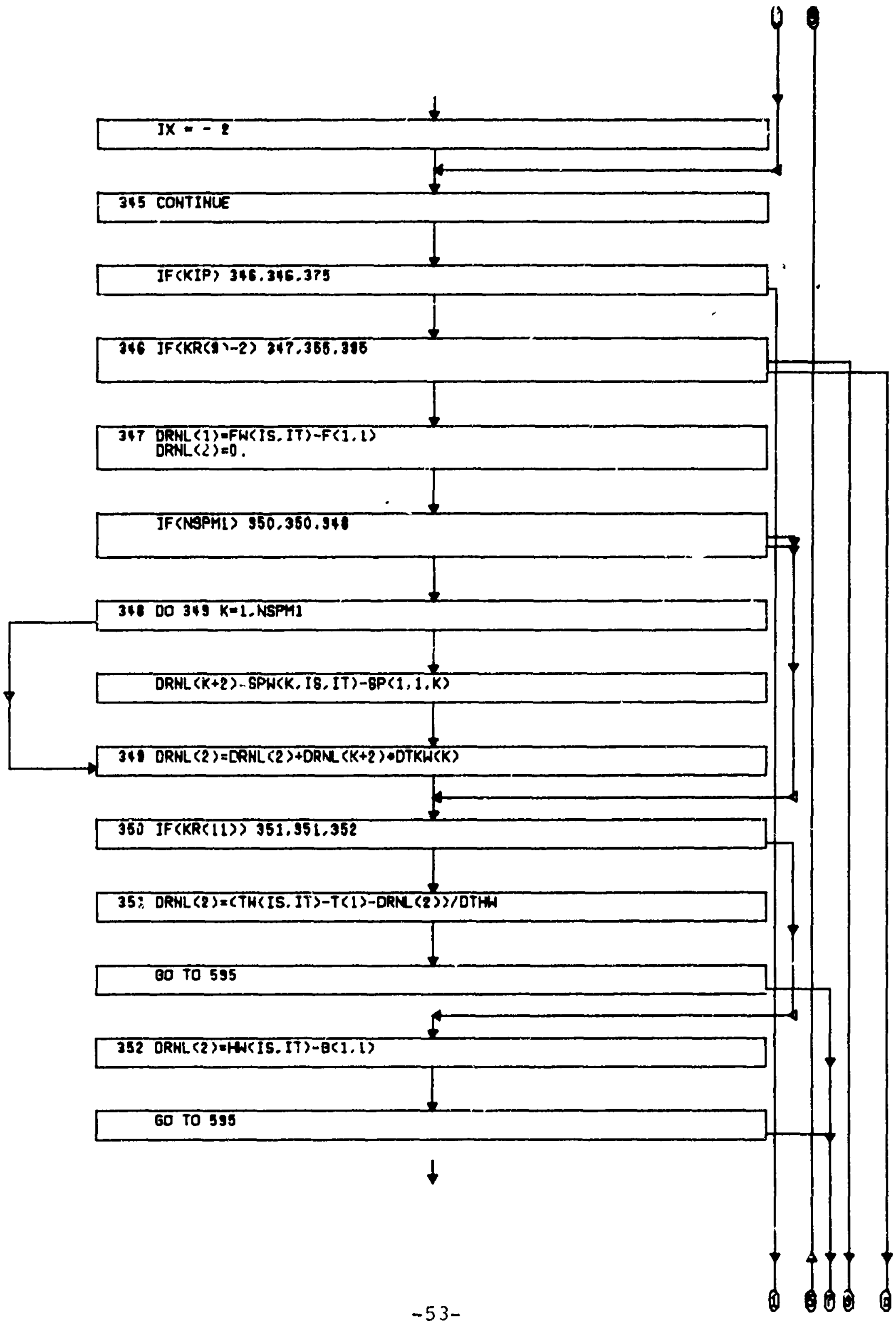
```
      AM(2,5) = DQJRNL(2,1) + DUM1 * DTHW + RHOVS                      B05A3390
      DO 470 K=1,NSPM1                                                 B05A3400
  470 AM(2,K + 5) = DQJRNL(K + 2,1) + DUM1 * DTKW(K)                   B05A3410
      IF (KR(9) - 4) 475,475,485                                       B05A3420
  475 DRNL(1)= VLNKW
      DO 472 K=1,NSP
      J=-IR(K)
      FNU(J)=VNU(ISU,J)
      IF (LEF(K) + LEFW(K))  471,471,472                                       *NEW
  471 FNU(J)=0.                                                                **-1
  472 CONTINUE
      DO 476 K=1,NSP
  476 DRNL(1)=DRNL(1)+YW(K)*FNU(K)
      AM(1,4) = 0.                                                     B05A3440
      DUM1 = TCW / T(1)                                                B05A3450
      AM(1,5) = DUM1 * DTHW
      DO 477 K=1,NSP
  477 AM(1,5)=AM(1,5)-DLPH(K)*FNU(K)
      DO 480 K=1,NSPM1                                                 B05A3470
      AM(1,K+5) = DUM1*DTKW(K)
      DO 480 KK=1,NSP
  480 AM(1,K+5)=AM(1,K+5)-DLPK(K,KK)*FNU(K)
      GOTO 510                                                         B05A3490
  485 IF (KR(9) - KIP - 5) 495,490,495                                 B05A3500
  490 WDOT = C3 * EXP( (ADUM * TW(IS,IT) + BDUM) * TW(IS,IT) + CDUM)   B05A3510
      AM(1,5) = 0.                                                     B05A3520
      KIP=KIP+1
      W(3) = WDOT                                                      B05A3540
      W(2) = 0.                                                        B05A3550
      W(1) = 0.                                                        B05A3560
      GOTO 295                                                         B05A3570
  495 WDOT = C3 * EXP( (ADUM * T(1) + BDUM) * T(1) + CDUM)             B05A3580
      AM(1,5) = WDOT * (ADUM * 2. * T(1) + BDUM)                       B05A3590
  500 DRNL(1) = RHOVS - WDOT                                           B05A3600
      DUM1 = ABS(DRNL(1))                                              B05A3610
      AM(1,4) = - C1                                                   B05A3620
      DO 505 K=1,NSPM1                                                 B05A3630
  505 AM(1,K + 5) = AM(1,5) * DTKW(K)                                  B05A3640
      AM(1,5) = AM(1,5) * DTHW                                         B05A3650
  510 DO 520 K=1,NSPM1                                                 B05A3660
      DRNL(K+2)=-WALLJ(K)-RHOVS*(SP(1,1,K)-YQ(K,L3)*WTM(K))+W(2)*WTM(K)*
     1 (TQ(K,L2)-YQ(K,L3))
      DO 515 KK=1,NRNL                                                 B05A3680
  515 AM(K + 2,KK + 3) = DQJRNL(KK,K + 1)                              B05A3690
      AM(K+2,4)=AM(K+2,4)+C1*(SP(1,1,K)-TQ(K,L3)*WTM(K))
  520 AM(K + 2,K + 5) = AM(K + 2,K + 5) + RHOVS                        B05A3710
      II = 0                                                           B05A3720
  525 IF(W(3)) 540,530,530
  530 DRNL(1)=(WDOT-W(3))/C1
      W(3)=WDOT
      DO 535 K=2,NRNL                                                  B05A3760
  535 DRNL(K) = DRNL(K) - DRNL(1) * AM(K,4)                            B05A3770
      II = 1                                                           B05A3780
  540 IXX = IX                                                         B05A3790
      CALL RERAY(NRNL-II,AM(II+1,II+4),0,DRNL(II+1),1,0,IXX,153)       B05C3800
      IF (KR(9) + KIP - 6) 560,545,560                                 B05A3820
  545 DTEMP = DRNL(2) * DTHW                                           B05A3830
      DO 550 K=1,NSPM1                                                 B05A3840
  550 DTEMP = DTEMP + DTKW(K) * DRNL(K + 2)                            B05A3850
      ATEMP = ABS(DTEMP)                                               B05A3860
```

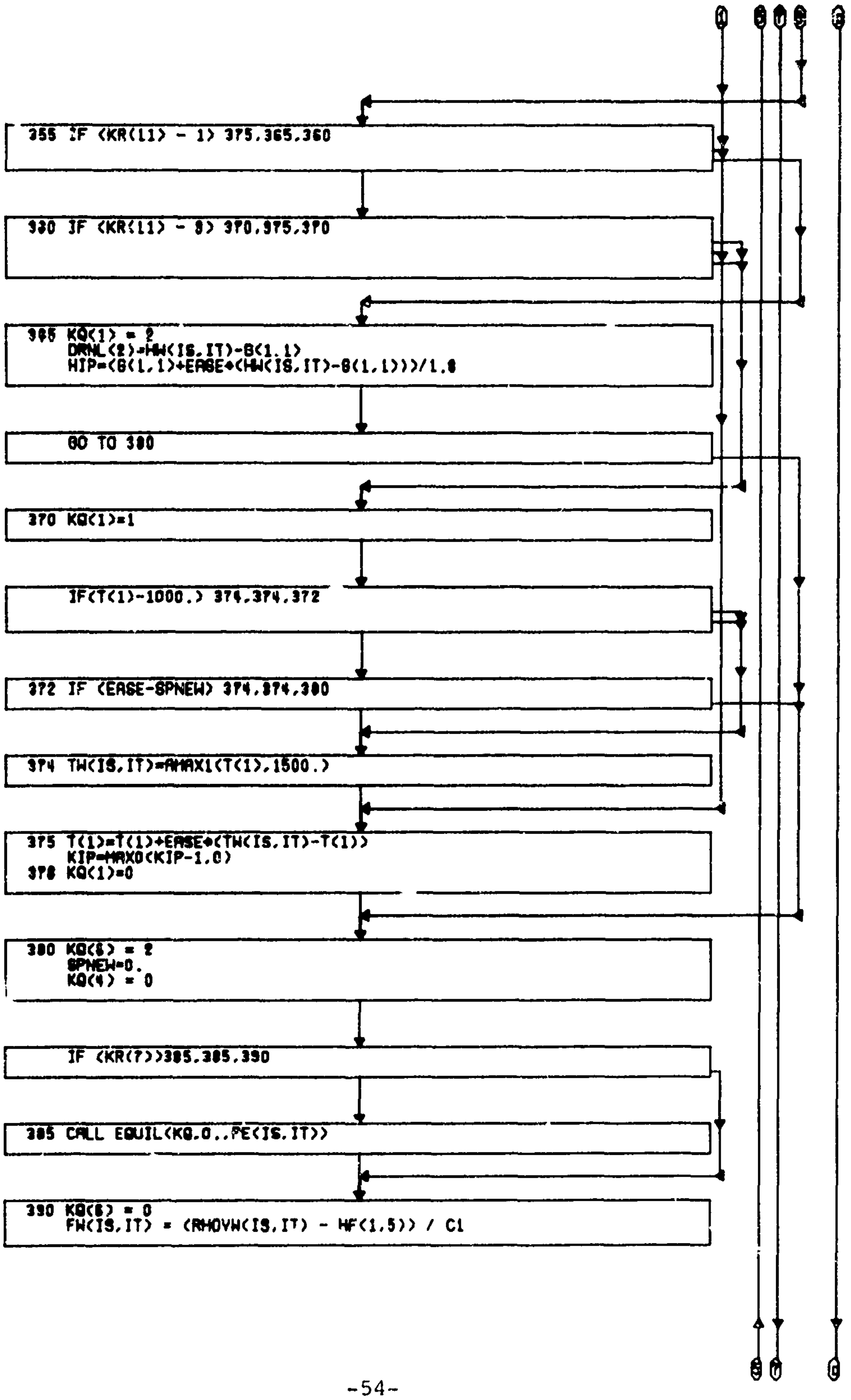
```
      IF (ATEMP - 50.) 555,560,415                                  805A3870
  555 TFZ = - T(1)                                                  805A3880
  560 CONTINUE                                                      805A3890
      WDOT=W(3)
  595 RETURN
      END                                                           805A5360
```

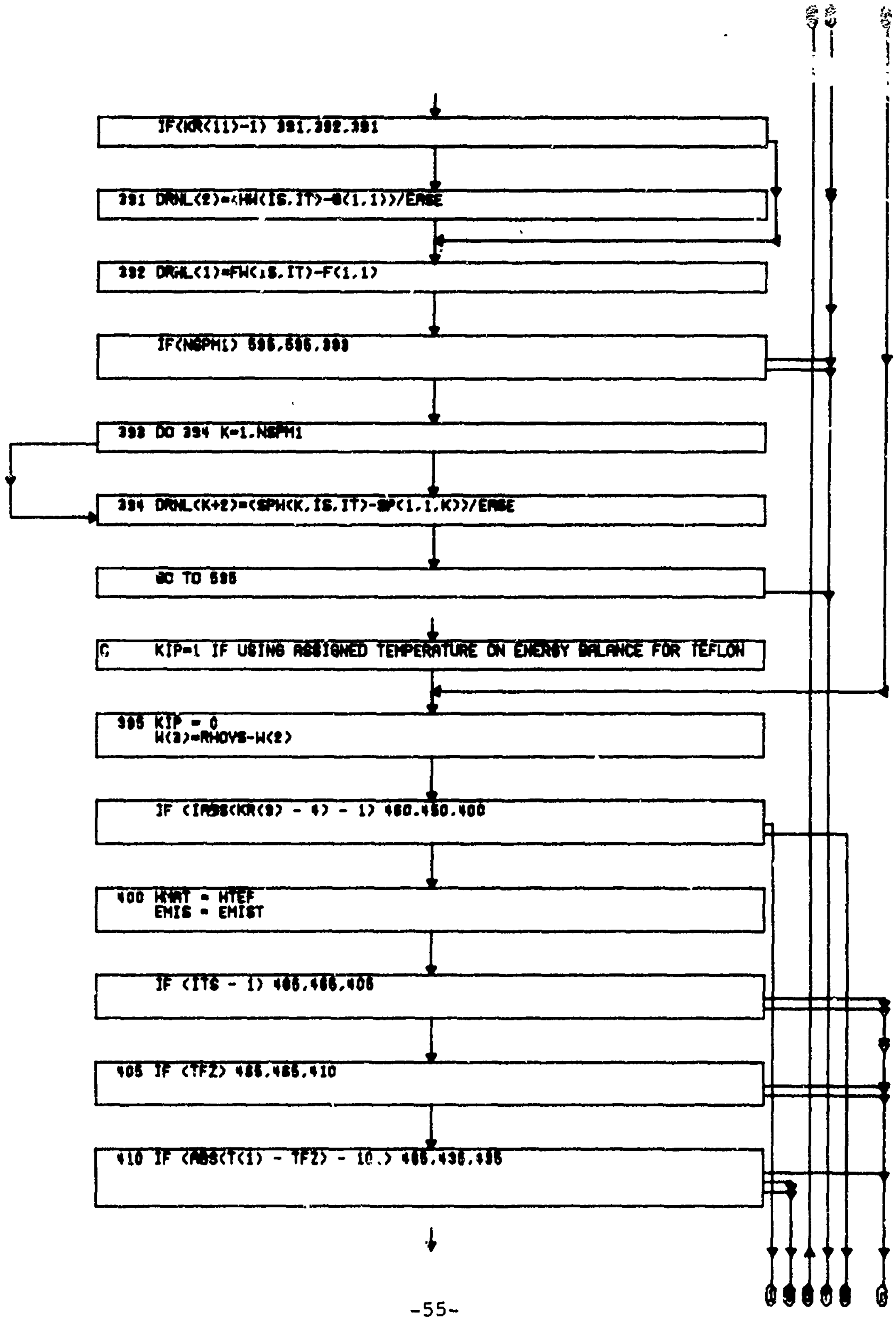
c. Flow Chart

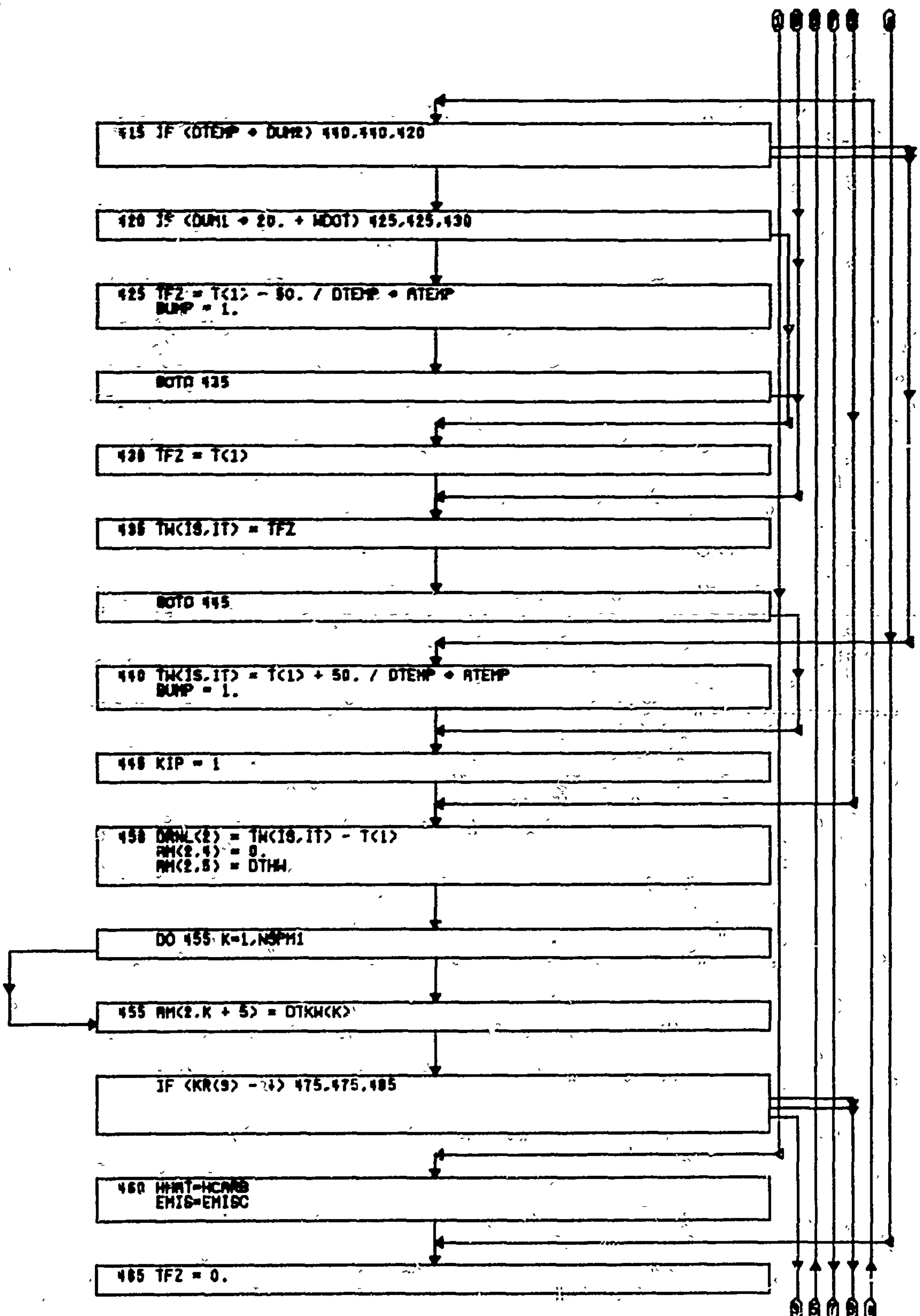

C SUBROUTINE RHLCER
C EVALUATES REDUCED SET OF DQNL AND DJNL. NOTE...DQNL FOLLOWED BY
C DJNL IS EQUIVALENCED TO DQJNL FOR CONVENIENCE OF FOLLOWING LOOP.
C ALSO, THE REDUCED SET DQJRNL IS EQUIV. TO AM(1) FOR STORAGE ECON.
DO 275 I=1.NRNL
M = I + NAM
L = LAR(M)
DO 275 K=1.NSP
DQJRNL(I.K) = DQJNL(L.K)
DO 275 J=1.NAM
JJ = LAR(J)
IF (I - 1) 275.270.275
RHOVS = C1 + F(1.1) + HF(1.5)
IF(KR(3)-2) 315.285.277
277 DO 278 K=1.NSP
278 WALLQJ(K)=WALLQJ(K)+DELQJH(K)

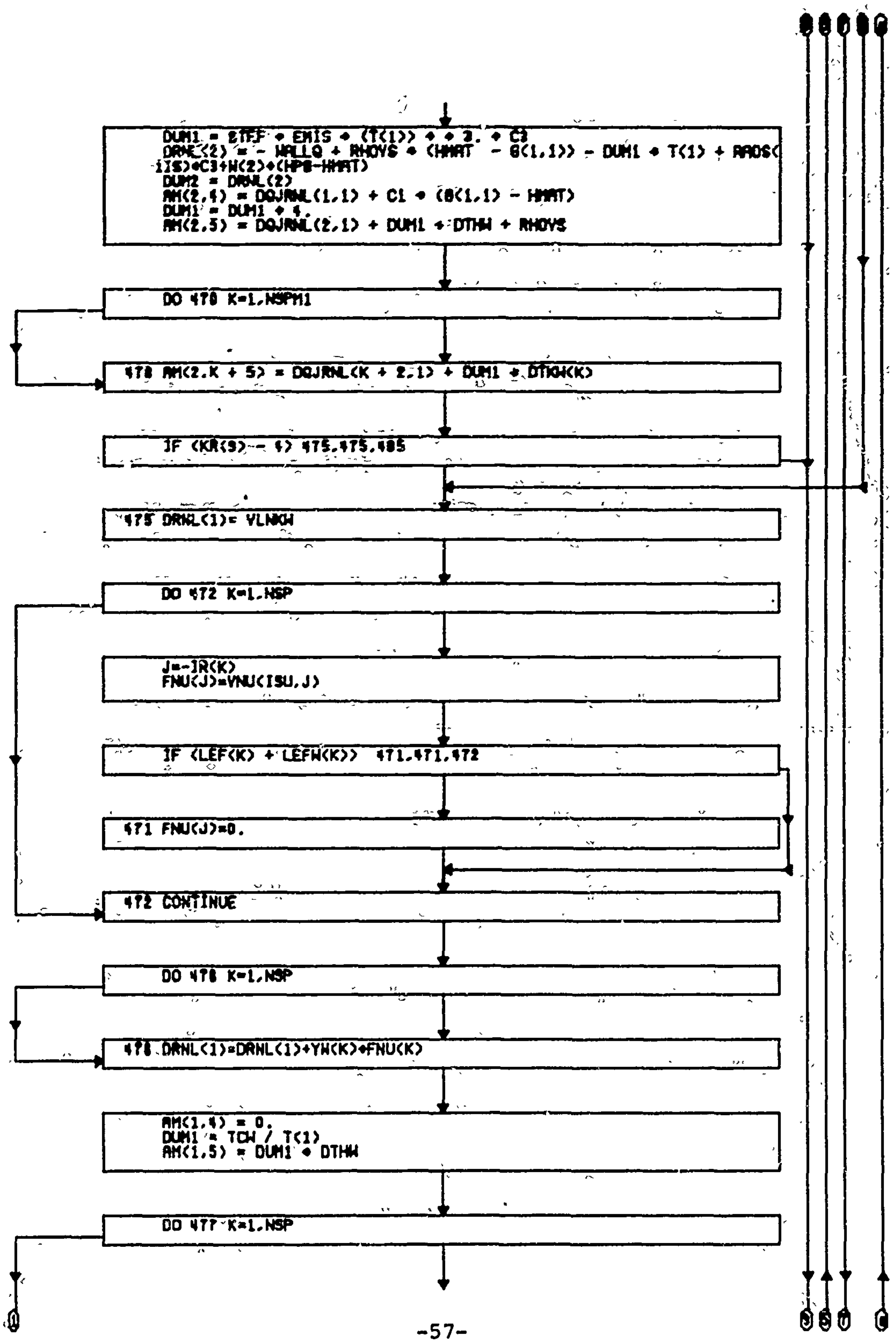

GO TO 315
285 DO 290 L=1,3
290 W(L) = FLUXJ(L,IS,IT)
C PREPARE DQJRNL AND WALLQJ FOR SURFACE MASS BALANCE
295 WSUM = W(1) + W(2) + W(3)
DO 310 K=2,NSP
WALLJ(K - 1) = WALLJ(K - 1) + DELQJW(K)
DQJRNL(1,K) = DQJRNL(1,K) / C1
WALLJ(K - 1) = WALLJ(K - 1) - DQJRNL(1,K) * RHOVS - DQJRNL(2,K) *
1S(1,1)
DO 310 KK=3,NRNL
310 WALLJ(K - 1) = WALLJ(K - 1) - DQJRNL(KK,K) * SP(1,1,KK - 2)
315 IF (KR(16) - 1) 345,340,320
320 IF (KR(17)) 340,340,335
325 FORMAT(52H DEBUG DQJRNL(NRNL,NSP) BY ROWS. DELQW(5),WALLQJ(5)/
1 (8X1P10E10.3))
330 FORMAT(35H DEBUG DQJNL(NNLEQ,NSP) ROW BY ROW /(8X1P10E10.3))
335 WRITE(KOUT,330)((DQJNL(I,K),K=1,NSP),I=1,NNLEQ)
340 WRITE(KOUT,325)((DQJRNL(I,K),K=1,NSP),I=1,NRNL),DELQW,DELJW,WALLQ,
1WALLJ

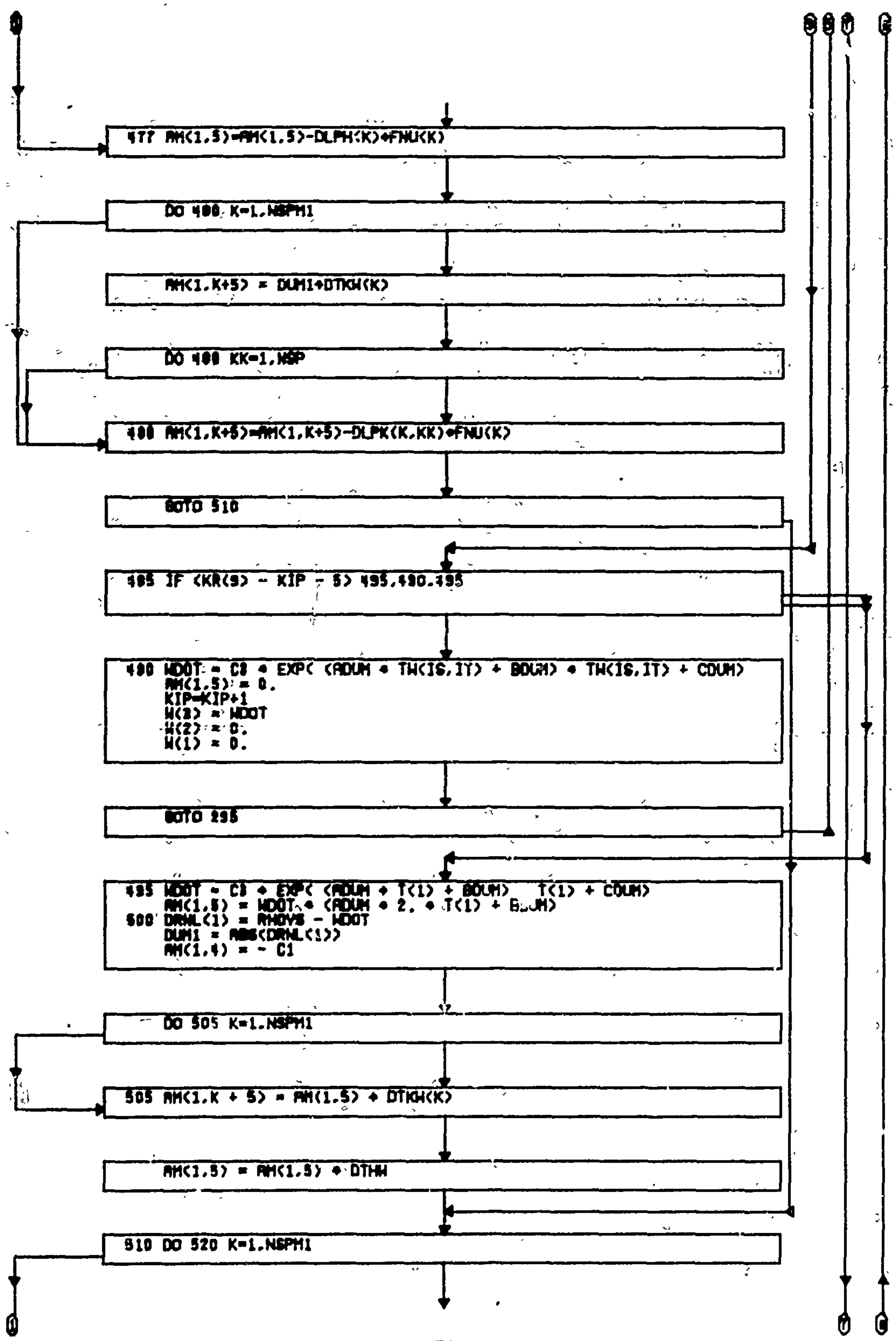

IX = - 2
345 CONTINUE
IF(KIP) 346,346,375
346 IF(KR(9)-2) 347,355,395
347 DRNL(1)=FW(IS,IT)-F(1,1)
DRNL(2)=0.
IF(NSPM1) 350,350,348
348 DO 349 K=1,NSPM1
DRNL(K+2)-SPW(K,IS,IT)-SP(1,1,K)
349 DRNL(2)=DRNL(2)+DRNL(K+2)*DTKW(K)
350 IF(KR(11)) 351,351,352
351 DRNL(2)=(TW(IS,IT)-T(1)-DRNL(2))/DTHW
GO TO 595
352 DRNL(2)=HW(IS,IT)-B(1,1)
GO TO 595

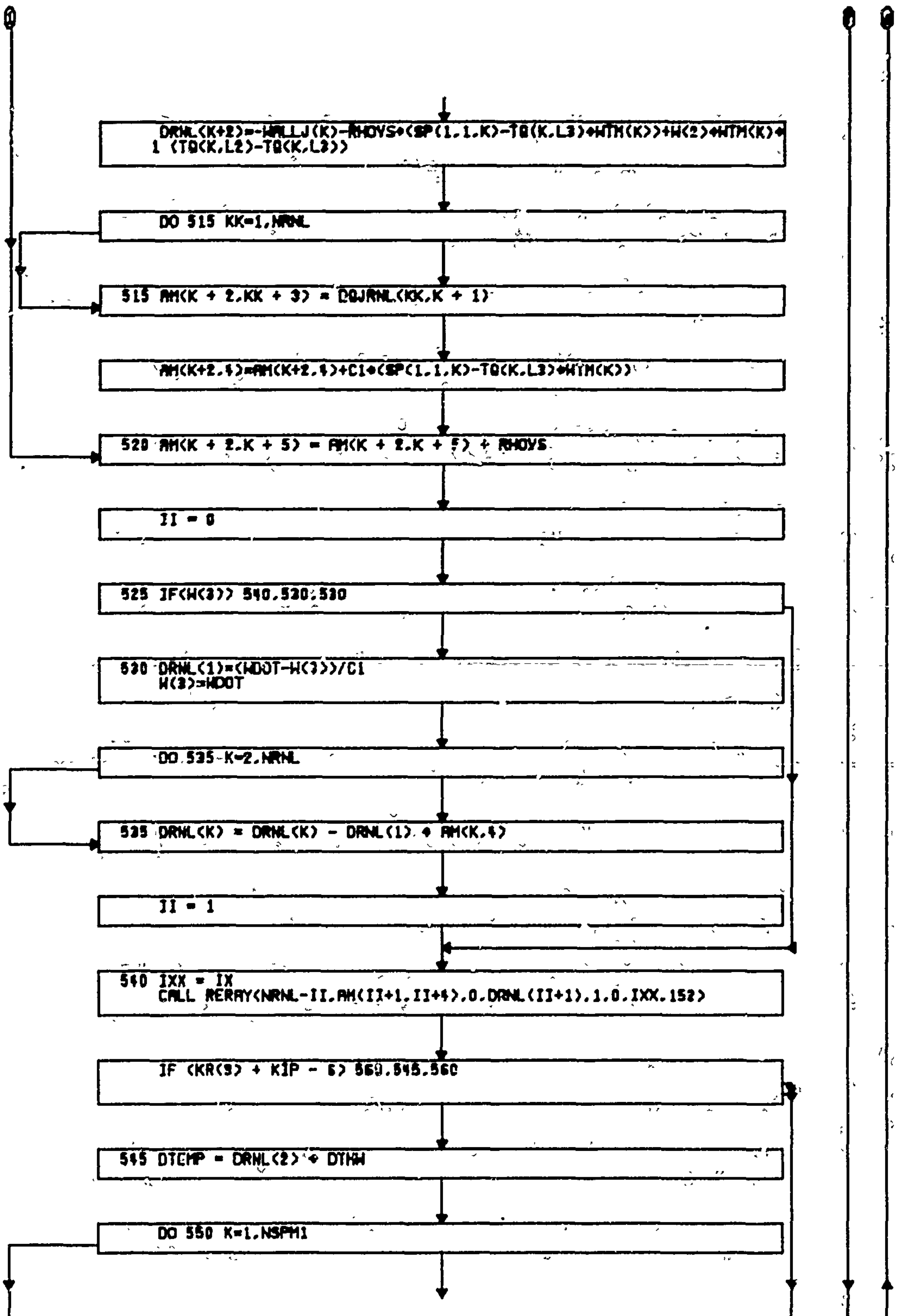

355 IF (KR(11) - 1) 375,365,360
360 IF (KR(11) - 8) 370,375,370
365 KQ(1) = 2
DRNL(2)=HW(IS,IT)-B(1,1)
HIP=(B(1,1)+EASE*(HW(IS,IT)-B(1,1)))/1.8
GO TO 380
370 KQ(1)=1
IF(T(1)-1000.) 374,374,372
372 IF (EASE-SPNEW) 374,374,380
374 TW(IS,IT)=AMAX1(T(1),1500.)
375 T(1)=T(1)+EASE*(TW(IS,IT)-T(1))
KIP=MAX0(KIP-1,0)
378 KQ(1)=0
380 KQ(5) = 2
SPNEW=0.
KQ(4) = 0
IF (KR(7))385,385,390
385 CALL EQUIL(KQ,0.,PE(IS,IT))
390 KQ(5) = 0
FW(IS,IT) = (RHOVW(IS,IT) - HF(1,5)) / C1

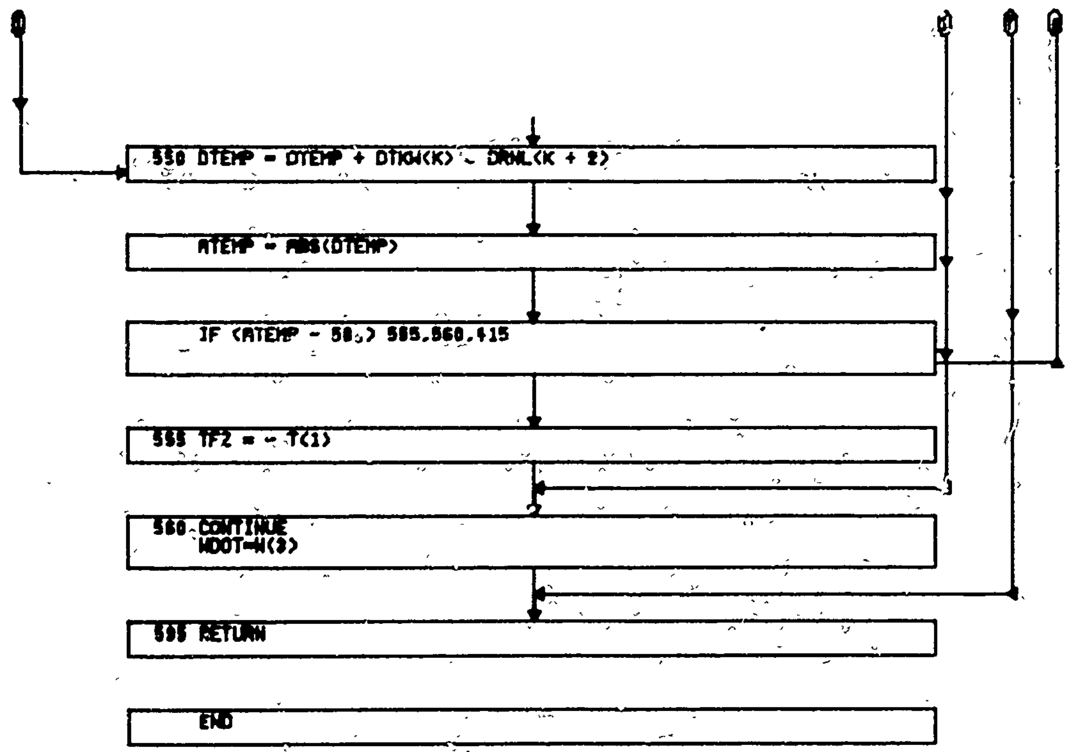

IF(KR(11)-1) 391,392,391
391 DRNL(2)=(HW(IS,IT)-G(1,1))/ERSE
392 DRNL(1)=FW(IS,IT)-F(1,1)
IF(NSPH1) 595,595,393
393 DO 394 K=1,NSPH1
394 DRNL(K+2)=(SPH(K,IS,IT)-SP(1,1,K))/ERSE
GO TO 595
C KIP=1 IF USING ASSIGNED TEMPERATURE ON ENERGY BALANCE FOR TEFLON
395 KIP = 0
W(3)=RHOVS-W(2)
IF (IABS(KR(9) - 4) - 1) 460,450,400
400 HWAT = HTEF
EMIS = EMIST
IF (ITS - 1) 485,485,405
405 IF (TFZ) 485,485,410
410 IF (ABS(T(1) - TFZ) - 10.) 485,435,435


415 IF (DTEMP + DUM2) 440,440,420
420 IF (DUM1 + 20. + WDOT) 425,425,430
425 TFZ = T(1) - 50. / DTEMP + ATEMP
BUMP = 1.
GOTO 435
430 TFZ = T(1)
435 TW(IS,IT) = TFZ
GOTO 445
440 TW(IS,IT) = T(1) + 50. / DTEMP + ATEMP
BUMP = 1.
445 KIP = 1
450 DRWL(2) = TW(IS,IT) - T(1)
AM(2,4) = 0.
AM(2,5) = DTHW
DO 455 K=1,NSPM1
455 AM(2,K + 5) = DTKW(K)
IF (KR(9) - 4) 475,475,485
460 HMAT=HCAMB
EMIS=EMISC
485 TFZ = 0.


DUM1 = STEF * EMIS * (T(1)) * * 3. * C3
DRNL(2) = - WALLQ + RHOVS * (HMAT - G(1,1)) - DUM1 * T(1) + RADS(
1IS)*C3+W(2)*(HP8-HMAT)
DUM2 = DRNL(2)
AM(2,4) = DQJRNL(1,1) + C1 * (G(1,1) - HMAT)
DUM1 = DUM1 * 4.
AM(2,5) = DQJRNL(2,1) + DUM1 * DTHW + RHOVS
DO 478 K=1,NSPM1
478 AM(2,K + 5) = DQJRNL(K + 2,1) + DUM1 * DTGW(K)
IF (KR(9) - 4) 475,475,485
475 DRNL(1)= VLNKW
DO 472 K=1,NSP
J=-IR(K)
FNU(J)=VNU(ISU,J)
IF (LEF(K) + LEFW(K)) 471,471,472
471 FNU(J)=0.
472 CONTINUE
DO 476 K=1,NSP
476 DRNL(1)=DRNL(1)+YW(K)*FNU(K)
AM(1,4) = 0.
DUM1 = TCW / T(1)
AM(1,5) = DUM1 * DTHW
DO 477 K=1,NSP


477 AM(1,5)=AM(1,5)-DLPH(K)*FNU(K)
DO 480 K=1,NSPM1
AM(1,K+5) = DUM1+DTKW(K)
DO 480 KK=1,NSP
480 AM(1,K+5)=AM(1,K+5)-DLPK(K,KK)*FNU(K)
GOTO 510
485 IF (KR(9) - KIP - 5) 495,490,495
490 WDOT = C8 * EXP((ADUM * TH(IS,IT) + BDUM) * TH(IS,IT) + CDUM)
AM(1,5) = 0.
KIP=KIP+1
W(3) = WDOT
W(2) = 0.
W(1) = 0.
GOTO 295
495 WDOT = C8 * EXP((ADUM * T(1) + BDUM) T(1) + CDUM)
AM(1,5) = WDOT * (ADUM * 2. * T(1) + BDUM)
500 DRNL(1) = RHOVS - WDOT
DUM1 = ABS(DRNL(1))
AM(1,4) = - C1
DO 505 K=1,NSPM1
505 AM(1,K + 5) = AM(1,5) + DTKW(K)
AM(1,5) = AM(1,5) + DTHW
510 DO 520 K=1,NSPM1


DRNL(K+2)=-WALLJ(K)-RHOYS*(SP(1,1,K)-TQ(K,L3)+WTM(K))+W(2)*WTM(K)*
1 (TQ(K,L2)-TQ(K,L3))
DO 515 KK=1,NRNL
515 AM(K + 2,KK + 3) = DQJRNL(KK,K + 1)
AM(K+2,4)=AM(K+2,4)+C1*(SP(1,1,K)-TQ(K,L3)*WTM(K))
520 AM(K + 2,K + 5) = AM(K + 2,K + 5) + RHOYS
II = 0
525 IF(W(3)) 540,530,530
530 DRNL(1)=(WDOT-W(3))/C1
W(3)=WDOT
DO 535 K=2,NRNL
535 DRNL(K) = DRNL(K) - DRNL(1) * AM(K,4)
II = 1
540 IXX = IX
CALL RERAY(NRNL-II,AM(II+1,II+4),0,DRNL(II+1),1,0,IXX,152)
IF (KR(9) + KIP - 6) 560,545,560
545 DTEMP = DRNL(2) * DTHW
DO 550 K=1,NSPM1


550 DTEMP = DTEMP + DTIGW(K) - DRNL(K + 2)
ATEMP = ABS(DTEMP)
IF (ATEMP - 50.) 585,560,415
555 TF2 = - T(1)
560 CONTINUE
WDOT=W(3)
585 RETURN
END

6. SUBROUTINE LINCER - B06A

a. Function

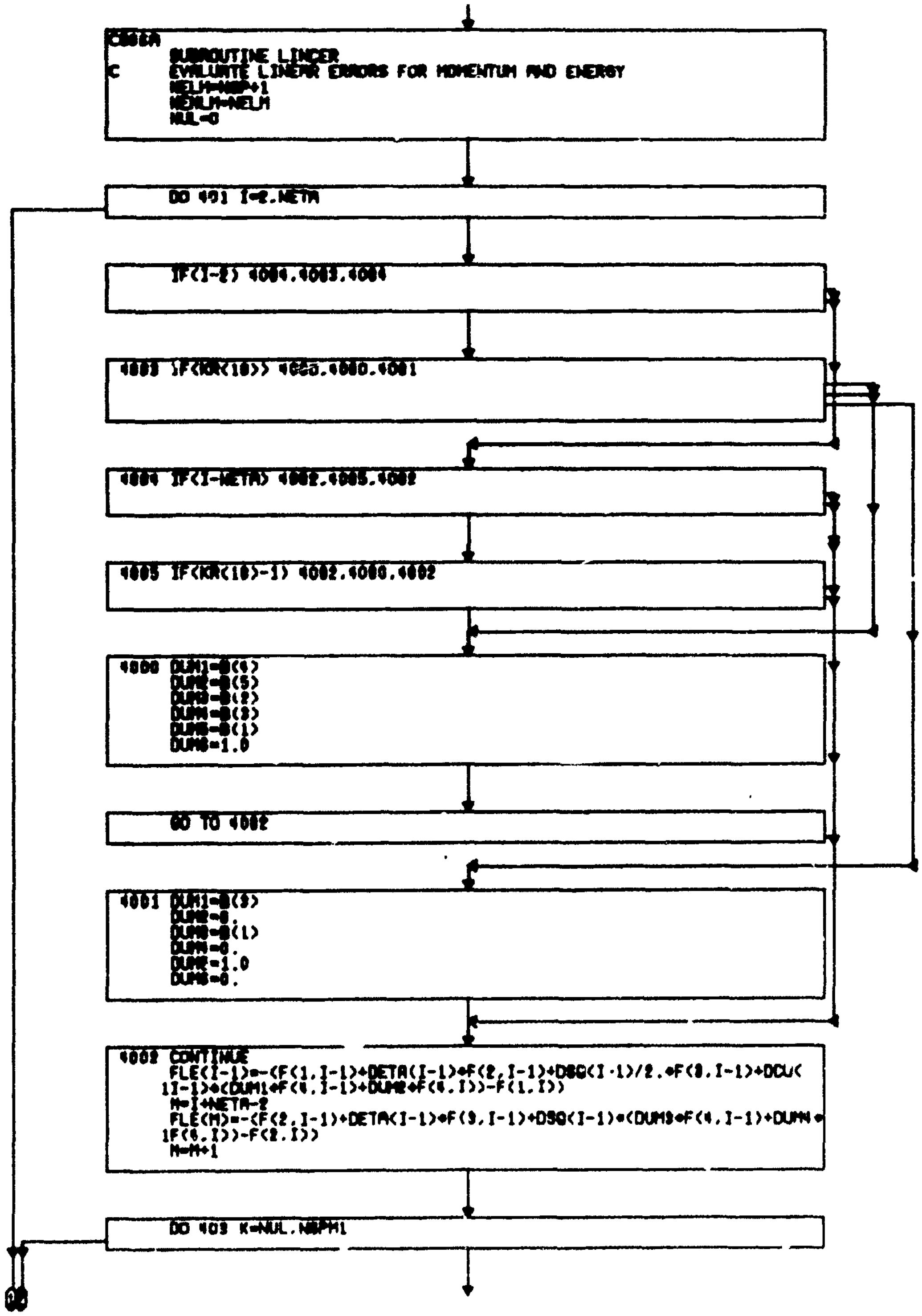
Evaluates errors for linear equations (i.e., Taylor series expansions and linear boundary conditions) and with the aid of its subroutines, determines maximum errors of linear equations and corrects errors for these linear equations for the matrix reduction which is performed on the linear equations (see discussion under subroutine MATS1). Called by ITERAT. Calls ABMAX, MATS1, MATS2.

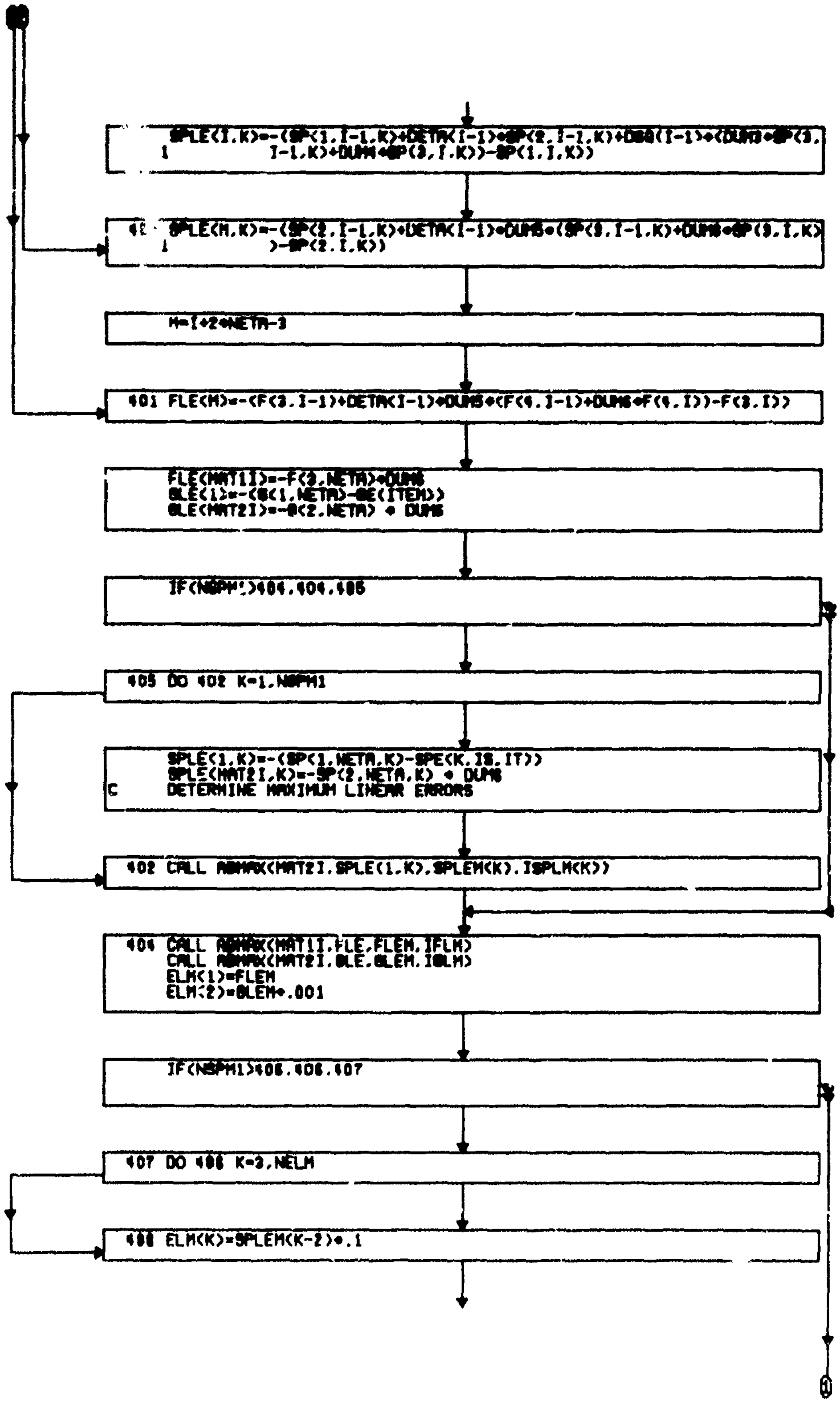
b. **Listing**

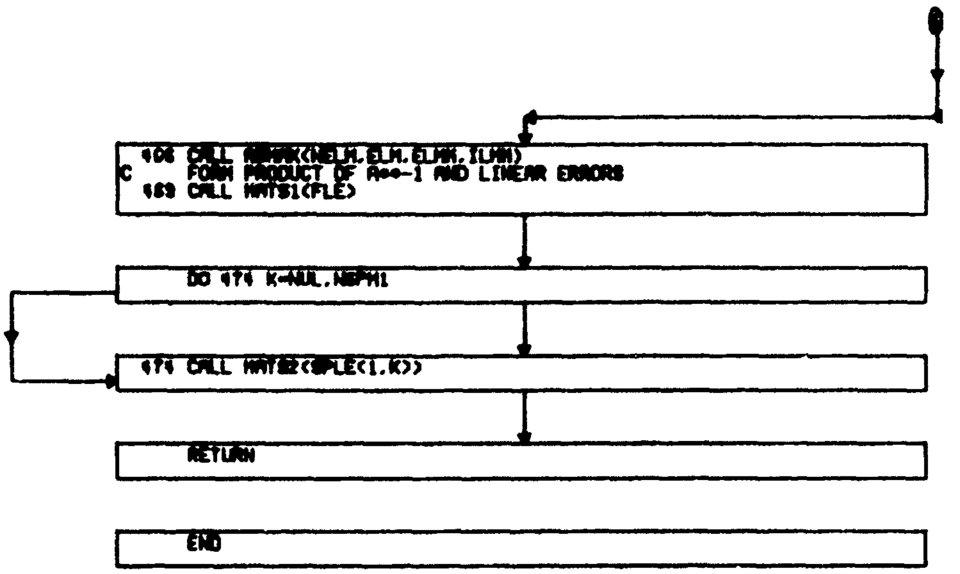
```
      CH06A                                                             B06A 001
            SUBROUTINE LINCER                                           B06A 002
            COMMON/EDGCOM/            PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B06A   3*NEW
           1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,WE,C90   B06A   4*NEW
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                    B06A   5*NEW
            COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM     B06A   6*NEW
           1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)     B06A   7*NEW
           2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)      B06A   8*NEW
           3,FNLEM,GNLEM,SPNLEM( 8),          ENLMM,IFNLM,IGNLM,ISPNLM( 8)    B06A   9*NEW
           4, NENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)             B06A  10*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)      B06A  11*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                                   B06A  12*NEW
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB06A  13*NEW
           1S,IT,NTIME,NSP,NSPM1,NAM,NLCO,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B06A  14*NEW
           2,B(8),       MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B06A  15*NEW
           3,KAUXO,JTIME,JSPEC,MD(3)                                          B06A  16*NEW
            COMMON/PRSCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(~J),ROKAP(40) B06A  17*NEW
           1,PNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B06A  18*NEW
           2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                            B06A  19*NEW
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B06A  20*NEW
      C     EVALUATE LINEAR ERRORS FOR MOMENTUM AND ENERGY                    B06A 018*-18
            NELM=NSP+1                                                        B06A 019
            NENLM=NELM                                                        B06A 020
            NUL=0
            DO 401 I=2,NETA
            IF(I-2) 4004,4003,4004
       4003 IF(KR(10)) 4000,4000,4001
       4004 IF(I-NETA) 4002,4005,4002
       4005 IF(KR(10)-1) 4002,4000,4002
       4000 DUM1=B(4)
            DUM2=B(5)
            DUM3=B(2)
            DUM4=B(3)
            DUM5=B(1)
            DUM6=1.0
            GO TO 4002
       4001 DUM1=B(3)
            DUM2=0.
            DUM3=B(1)
            DUM4=0.
            DUM5=1.0
            DUM6=0.
       4002 CONTINUE
            FLE(I-1)=-(F(1,I-1)+DETA(I-1)*F(2,I-1)+DSQ(I-1)/2.*F(3,I-1)+DCU(
           1I-1)*(DUM1*F(4,I-1)+DUM2*F(4,I))-F(1,I))
            M=I+NETA-2
            FLE(M)=-(F(2,I-1)+DETA(I-1)*F(3,I-1)+DSQ(I-1)*(DUM3*F(4,I-1)+DUM4*
           1F(4,I))-F(2,I))
            N=M+1
            DO 403 K=NUL,NSPM1
            SPLE(I,K)=-(SP(1,I-1,K)+DETA(I-1)*SP(2,I-1,K)+DSQ(I-1)*(DUM3*SP(3,
           1           I-1,K)+DUM4*SP(3,I,K))-SP(1,I,K))
        403 SPLE(M,K)=-(SP(2,I-1,K)+DETA(I-1)*DUM5*(SP(3,I-1,K)+DUM6*SP(3,I,K)
           1           )-SP(2,I,K))
            M=I+2*NETA-3
        401 FLE(M)=-(F(3,I-1)+DETA(I-1)*DUM5*(F(4,I-1)+DUM6*F(4,I))-F(3,I))
            FLE(MAT1I)=-F(3,NETA)*DUM6
            GLE(1)=-(G(1,NETA)-GE(ITEM))
```

```
      GLE(MAT2I)=-G(2,NETA) * DUM6
      IF(NSPM1)404,404,405
  405 DO 402 K=1,NSPM1
      SPLE(1,K)=-(SP(1,NETA,K)-SPE(K,IS,IT))                          B06A 044
      SPLE(MAT2I,K)=-SP(2,NETA,K) * DUM6
C     DETERMINE MAXIMUM LINEAR ERRORS                                 B06A 046
  402 CALL ABMAX(MAT2I,SPLE(1,K),SPLEM(K),ISPLM(K))                   B06A 047
  404 CALL ABMAX(MAT1I,FLE,FLEM,IFLM)                                 B06A 048
      CALL ABMAX(MAT2I,GLE,GLEM,IGLM)                                 B06A 049
      ELM(1)=FLEM                                                     B06A 051
      ELM(2)=GLEM*.001                                                B06A 052
      IF(NSPM1)406,406,407                                            B06A 053
  407 DO 406 K=3,NELM                                                 B06A 054
  406 ELM(K)=SPLEM(K-2)*.1                                            B06A 055
  406 CALL ABMAX(NELM,ELM,ELMM,ILMM)                                  B06A 056
C     FORM PRODUCT OF A**-1 AND LINEAR ERRORS                         B06A 057
  469 CALL MATS1(FLE)                                                 B06A 058
      DO 474 K=LL,NSPM1
  474 CALL MATS2(SPLE(1,K))                                           B06A 062
      RETURN                                                          B06A 065
      END                                                             B06A 066
```

c. Flow Chart


C006A
SUBROUTINE LINCER
C EVALUATE LINEAR ERRORS FOR MOMENTUM AND ENERGY
NELM=NBP+1
NENLM=NELM
NUL=0
DO 401 I=2,NETA
IF(I-2) 4004,4003,4004
4003 IF(KR(10)) 4000,4000,4001
4004 IF(I-NETA) 4002,4005,4002
4005 IF(KR(10)-1) 4002,4000,4002
4000 DUM1=B(4)
DUM2=B(5)
DUM3=B(2)
DUM4=B(3)
DUM5=B(1)
DUM6=1.0
GO TO 4002
4001 DUM1=B(3)
DUM2=0.
DUM3=B(1)
DUM4=0.
DUM5=1.0
DUM6=0.
4002 CONTINUE
FLE(I-1)=-(F(1,I-1)+DETA(I-1)*F(2,I-1)+DSQ(I-1)/2.*F(3,I-1)+DCU(
1I-1)*(DUM1*F(4,I-1)+DUM2*F(4,I))-F(1,I))
M=I+NETA-2
FLE(M)=-(F(2,I-1)+DETA(I-1)*F(3,I-1)+DSQ(I-1)*(DUM3*F(4,I-1)+DUM4*
1F(4,I))-F(2,I))
M=M+1
DO 403 K=NUL,NBPM1
03


SPLE(I,K)=-(SP(1,I-1,K)+DETA(I-1)*SP(2,I-1,K)+DSQ(I-1)*(DUM3*SP(3,
1 I-1,K)+DUM4*SP(3,I,K))-SP(1,I,K))
SPLE(M,K)=-(SP(2,I-1,K)+DETA(I-1)*DUM5*(SP(3,I-1,K)+DUM6*SP(3,I,K)
1)-SP(2,I,K))
M=I+2*NETA-3
401 FLE(M)=-(F(3,I-1)+DETA(I-1)*DUM5*(F(4,I-1)+DUM6*F(4,I))-F(3,I))
FLE(MAT1I)=-F(3,NETA)*DUM6
GLE(1)=-(G(1,NETA)-GE(ITEM))
GLE(MAT2I)=-G(2,NETA) * DUM6
IF(NSPM1)404,404,405
405 DO 402 K=1,NSPM1
SPLE(1,K)=-(SP(1,NETA,K)-SPE(K,IS,IT))
SPLE(MAT2I,K)=-SP(2,NETA,K) * DUM6
C DETERMINE MAXIMUM LINEAR ERRORS
402 CALL ABMAX(MAT2I,SPLE(1,K),SPLEM(K),ISPLM(K))
404 CALL ABMAX(MAT1I,FLE,FLEM,IFLM)
CALL ABMAX(MAT2I,GLE,GLEM,IGLM)
ELM(1)=FLEM
ELM(2)=GLEM*.001
IF(NSPM1)406,406,407
407 DO 408 K=3,NELM
408 ELM(K)=SPLEM(K-2)*.1


C FORM PRODUCT OF A**-1 AND LINEAR ERRORS
CALL MATS1(FLE)
RETURN
END

7. SUBROUTINE REFCON - B07A

a. Function

Calculates boundary layer edge conditions and sets up wall boundary conditions for uncoupled problems. Called by SETUP. Calls INPUT, EQUIL, SLOPQ.

b. Listing

```
      CH07A                                                             B07A 001
            SUBROUTINE REFCON                                           B07A 002
            COMMON/EDGCOM/              PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B07A   3*NEW
           1HE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90  B07A   4*NEW
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                              B07A   5*NEW
            COMMON/MISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, *B07A   6*NEW
           1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B07A   7*NEW
           2,F3M(40),ETAM(40)                                           B07A   8*NEW
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB07A   9*NEW
           1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CRAR,CASE(15) B07A  10*NEW
           2,Z(3),      NWE,MON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B07A  11*NEW
           3,ZAUXO,JTIME,JSPEC,MD(3)                                    B07A  12*NEW
            COMMON/PRECOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B07A  13*NEW
           1,PNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B07A  14*NEW
           2CONF,RADFL( 50),RADR(40),RADS(40),IRAD                      B07A  15*NEW
            COMMON/TESCOM/SPDUM( 8),DFR(40),DUMM1(15),SLOPE(15),REDUM(15)     B07A  16*NEW
           1,SDUM1(40),SDUM2(40),FWDUM(40),XICON(40),FWCON(40),FWINIT( 1)     B07A  17*NEW
           2,XIINIT( 1),DUDR( 40)                                       B07A  18*NEW
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH              B07A  19*NEW
            COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)   B07A  20*NEW
           1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      B07A  21*NEW
      7007 FORMAT(8E10.4)                                               B07A 024*-19
      9901 FORMAT(I3,7E10.3)                                            B07A 025
       106 FORMAT(I2)                                                   B07A 026
        15 FORMAT(1H1)
        16 FORMAT (/,1X,23HDISTANCE,FT            ,8E12.5/(24X,8E12.5))  B07A 027
        17 FORMAT (/,1X,23HPRESSURE RATIO         ,8E12.5/(24X,8E12.5))  B07A 028
        18 FORMAT (/,1X,23HENTROPY DROP,BTU/LB R  ,8E12.5/(24X,8E12.5))  B07A 029
        19 FORMAT (/,1X,23HWALL ENTHALPY,BTU/LB   ,8E12.5/(24X,8E12.5))  B07A 030
        20 FORMAT (/,1X,23HWALL TEMPERATURE,DEG R ,8E12.5/(24X,8E12.5))  B07A 031
        21 FORMAT (/,1X,23HWALL STREAM FUNCTION   ,8E12.5/(24X,8E12.5))  B07A 032
        22 FORMAT (/,1X,23HMASS FLUX,LB/SEC FT**2 ,8E12.5/(24X,8E12.5))  B07A 033
        23 FORMAT (/,1X,23HELEMENTAL MASS FRACTION,8E12.5/(24X,8E12.5))  B07A 034
        24 FORMAT (/,1X,23HCOMP FLUX,LB/SEC FT**2 ,8E12.5/(24X,8E12.5))  B07A 035
        25 FORMAT (/,1X,23HSTATIC PRESSURE,ATM    ,8E12.5/(24X,8E12.5))  B07A 036
        26 FORMAT (/,1X,23HXI,(LB/SEC)**2         ,8E12.5/(24X,8E12.5))  B07A 037
        27 FORMAT (/,1X,23HBETA                   ,8E12.5/(24X,8E12.5))  B07A 038
        28 FORMAT (/,1X,23HROKAP                  ,8E12.5/(24X,8E12.5))  B07A 039
        29 FORMAT (/,1X,23HEDGE VELOCITY,FT/SEC   ,8E12.5/(24X,8E12.5))  B07A 040
        30 FORMAT (/,1X,23HNORMALIZED MASS FLUX   ,8E12.5/(24X,8E12.5))  B07A 041
        31 FORMAT (/,1X,23HNORMALIZED COMP FLUX   ,8E12.5/(24X,8E12.5))  B07A 042
        32 FORMAT (/,1X,23HINCIDENT RADIATION FLUX,8E12.5/(24X,8E12.5))
        33 FORMAT(/,1X,23H-1/FLUX NORM,PARAMETER ,8E12.5/(24X,8E12.5))   B07A 044
      1532 IF (ITEM-1) 1539,1538,1539                                   B07A 051
      1538 IDSIP=1                                                      B07A 052
           IPRE=1                                                       B07A 053
           IRAD=1
           DO 1540 I=1,NS                                               B07A 054
      1540 DSIP(I)=0.                                                   B07A 055
      1539 IF (KR(5)-5) 1536,1537,1536                                  B07A 056
      1537 IF (IDSIP-ITEM) 1536,1535,1536                               B07A 057
      1535 READ (KIN,7007) (DSIP(I),I=1,NS)                             B07A 058
           READ (KIN,106) IDSIP                                         B07A 059
      1536 IF (IPRE-ITEM) 1534,1533,1534                                B07A 060
      1533 READ (KIN,7007) (PRE(I),I=1,NS)                              B07A 061
           READ (KIN,106) IPRE                                          B07A 062
      1534 IF(PRE(1)) 1541,1542,1541
      1542 DO 1543 I=2,NS
```

```
      IF(PRE(I)) 1544,1543,1544
 1544 L=I
      GO TO 1545
 1543 CONTINUE
 1545 RNOSE=S(L)/SQRT(1.-PRE(L))
      DO 1546 I=2,L
 1546 PRE(I-1)=1.-S(I-1)/RNOSE*S(I-1)/RNOSE
 1541 DO 1531 I=1,NS
      PTE(I ,1)=PTET(ITEM)                                              B07A 064
 1531 PE(I ,1)=PTE(I ,1)*PRE(I )                                        B07A 065
      IF (IRAD-ITEM)1554,1552,1554
 1552 READ (KIN,7007) (RADR(I),I=1,NS)
      READ (KIN,105) IRAD
 1554 DO 1553 I=1,NS
 1553 RADS(I)=RADFL(ITEM)*RADR(I)
  105 DO 104 IS=1,NS                                                    B07A 066
  201 IF (IS-1) 207,207,203                                             B07A 068
C     THE FOLLOWING PROCEDURE DOES NOT APPLY FOR NONEQUIL OR ENTROPY LA.B07A 069
  207 KQ(1)=2                                                           B07A 070
      KQ(5)=2                                                           B07A 071
      KQ(6)=0                                                           B07A 072
      KQ(4)=0                                                           B07A 073
      IF (KR(7))8003,8003,8002                                          B07A
 8002 CALL STATE
      WRITE(KOUT,992)
      WRITE(KOUT,994)
  992 FORMAT(1H1,10X20HISENTROPIC EXPANSION /12X15HEDGE CONDITIONS //)
  994 FORMAT(5X117HSTREAMWISE      TEMP          CP          STATIC      DENS
     1ITY    VISCOSITY    VELOCITY    ENTHALPY    ENTROPY      MACH NO. /
     25X45HDIMENSION                      FROZEN      PRESSURE /7X101H(FEET)
     3    (DEG R)      (BTU/          (ATM)       (LB/CU FT)  (LB/SEC FT)  (FT
     4/SEC       (BTU/LB)       (BTU/  /30X10HLB DEG R) 62X10HLB DEG R)  /)
      GO TO 8004                                                        B07A
 8003 CALL EQUIL(KQ,GF(ITEM),PTE(1,IT))                                 B07A
 8004 KQ(1)=3                                                           B07A
      KQ(2)=0                                                           B07A 076
      KQ(3)=6                                                           B07A 077
      KQ(5)=1                                                           B07A 078
      IF(KR(6)-2) 210,203,203
  203 IF (KR(7))8006,8006,8005                                          B07A
 8005 CALL STATE
      GO TO 210
 8006 CALL EQUIL(KQ,0.,PE(IS,IT))                                       B07A
  210 IF (NSPM1)205,205,215
  215 DO 216 K=1,NSPM1                                                  B07A 084
  216 SPE(K,IS,IT)=SP(1,NETA,K)                                         B07A 085
  205 IF(KR(15)) 9903,9904,9903                                         B07A 096
 9903 CONTINUE                                                          B07A 097
      WRITE(KOUT,9901)IS,HE,UE(IS),PTE(IS,1),TE(IS),RHOE(IS),VMUE(IS)   B07A 098
 9904 CONTINUE                                                          B07A 099
  104 CONTINUE                                                          B07A 100
C     END OF EDGE PROPERTY LOOP, START OF BETA AND XI CALCULATION       B07A 101
      UEDGE=1.0                                                         B07A 102
      DUEDGE=0.                                                         B07A 103
      D2UEDG=0.                                                         B07A 104
  605 XI(1)=0.                                                          B07A 105
      J=NDISC+1                                                         B07A 106
      DO 111 II=1,J                                                     B07A 107
      K=NSD(II)                                                         B07A 108
      M=MSD(II)                                                         B07A 109
```

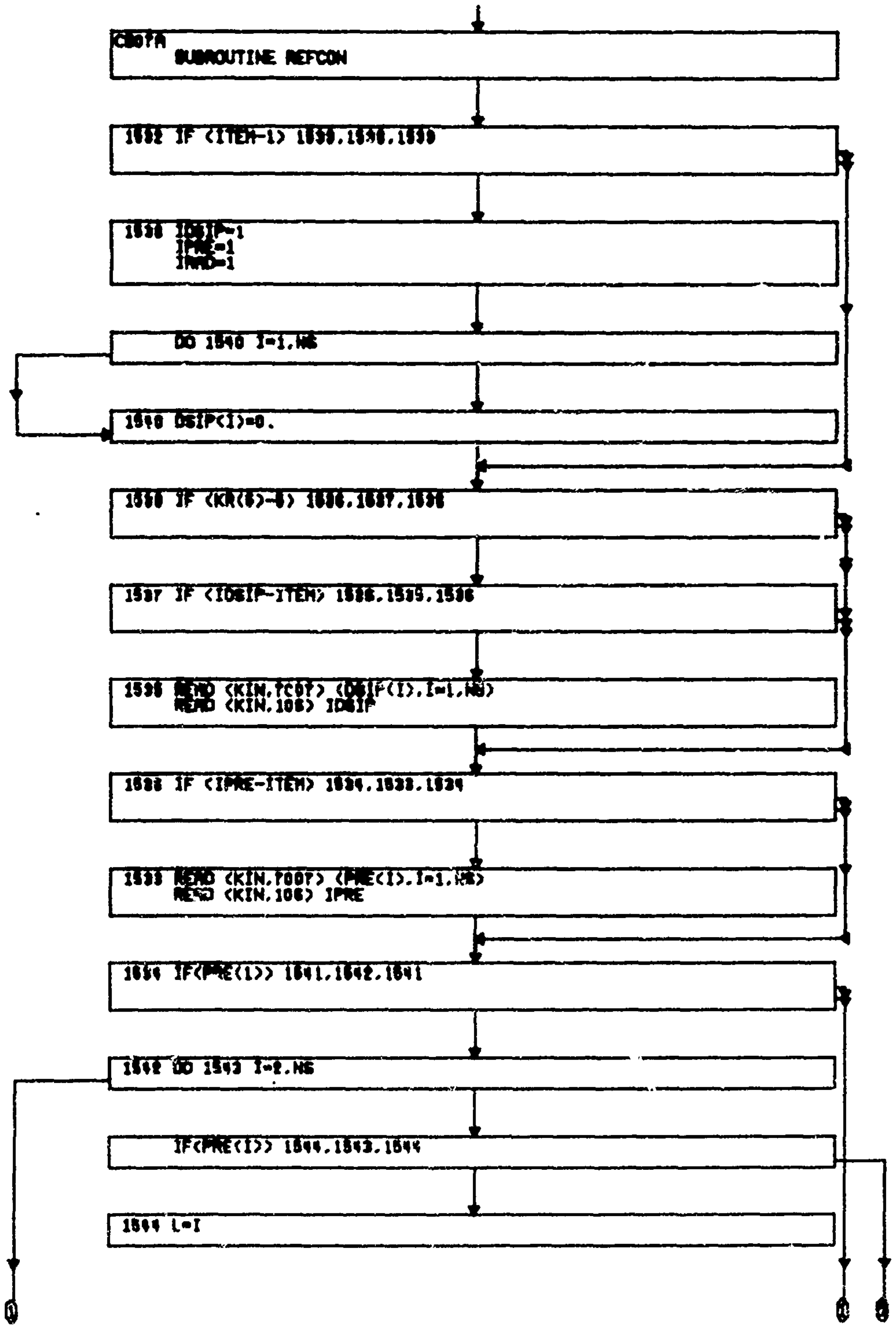
```
      MM=M+1
      LL=K+M-1                                                          B07A 110
      IF (II-1) 6052,6052, 402                                          B07A 111
 4052 IF (KR(6)-1) 400,401,402                                          B07A 112
C     AXISYMETRIC BLUNT                                                 B07A 113
  400 DO 403 I=M,LL                                                     B07A 114
      SDUM2(I)=S(I)*S(I)                                                B07A 115
      IF(S(I)) 403,403,4031                                             B07A 116
 4031 DUM1=ROKAP(I)/S(I)                                                B07A 117
      XICON(I)=UE(I)/S(I)*RHOE(I)/4.*VMUE(I)*DUM1*DUM1                  B07A 118
  403 SDUM1(I)=SDUM2(I)*SDUM2(I)                                        B07A 119
      QI=4.                                                             B07A 120
      BETAM(1)=0.5                                                      B07A 121
      GO TO 406                                                         B07A 122
C     PLANAR BLUNT                                                      B07A 123
  401 DO 404 I=M,LL                                                     B07A 124
      SDUM2(I)=S(I)                                                     B07A 125
      IF(S(I)) 404,404,4041                                             B07A 126
 4041 XICON(I)=UE(I)/S(I)*RHOE(I)/2.*VMUE(I)                            B07A 127
  404 SDUM1(I)=S(I)*S(I)                                                B07A 128
      QI=2.                                                             B07A 129
      BETAM(1)=1.                                                       B07A 130
      GO TO 406                                                         B07A 131
  402 IF (KR(6)-2) 408,407,408                                          B07A 132
C     AXISYMETRIC SHARP                                                 B07A 133
  407 DO 409 I=M,LL                                                     B07A 134
      SDUM2(I)=S(I)*S(I)                                                B07A 135
      DUM1=ROKAP(I)/S(I)                                                B07A 136
      XICON(I)=RHOE(I)*UE(I)*VMUE(I)*DUM1/3.*DUM1                       B07A 137
  409 SDUM1(I)=S(I)*SDUM2(I)                                            B07A 138
      XI(1)       =XICON(1)*S(1)*S(1)*S(1)                              B07A 139
      QI=3.                                                             B07A 140
      IF (II-1) 4051,4051,406
C     PLANAR SHARP                                                      B07A 142
  408 DO 405 I=M,LL                                                     B07A 143
      SDUM2(I)=S(I)                                                     B07A 144
      XICON(I)=RHOE(I)*UE(I)*VMUE(I)*JKAP(I)*ROKAP(I)                   B07A 145
  405 SDUM1(I)=S(I)                                                     B07A 146
      QI=1.                                                             B07A 147
      IF (II-1) 4052,4052,406
 4052 XI(1)       =XICON(1)*S(1)                                        B07A 149
 4051 MM=M
  406 CONTINUE                                                          B07A 152
      CALL SLOPQ(K,S(M),UE(M),DUDS(M),DER(M))                           B07A 153
      IF (KR(6)-2) 4066,4062,4062                                       B07A 154
 4066 IF (M-1) 4061,4061,4062                                           B07A 155
 4061 IF (RNOSE) 4063,4063,4064                                         B07A 156
COMMENT...DUES COMPUTED BY SLOPQ                                        B07A 157
 4063 DUES=DUDS(1)                                                      B07A 158
      GO TO 4065                                                        B07A 159
COMMENT...DUES FROM EFFECTIVE NOSE RADIUS USING NEWTONIAN FLOW          B07A 160
 4064 DUES=SQRT(2./RHOE(1)*PE(1,IT)*32.1740*2116.)/RNOSE                B07A 161
 4065 XICON( 1)=RHOE( 1)*VMUE( 1)/(2.*VKAP+2.)*DUES                     B07A 162
 4062 CALL SLOPQ(K,SDUM1(M) XICON(M),DER(M),XI(M))                      B07A 163
      IF (LL-MM) 111,4101,4101                                          B07A 165
 4101 DO 410 L=MM,LL                                                    B07A 166
  410 BETAM(L)=2./QI*XI(L)/UE(L)*S(L)/SDUM1(L)*DUDS(L)/XICON(L)         B07A 167
  111 CONTINUE                                                          B07A 168
 9803 FORMAT(8E10.4)                                                    B07A 172
      WRITE(KOUT,15)
```

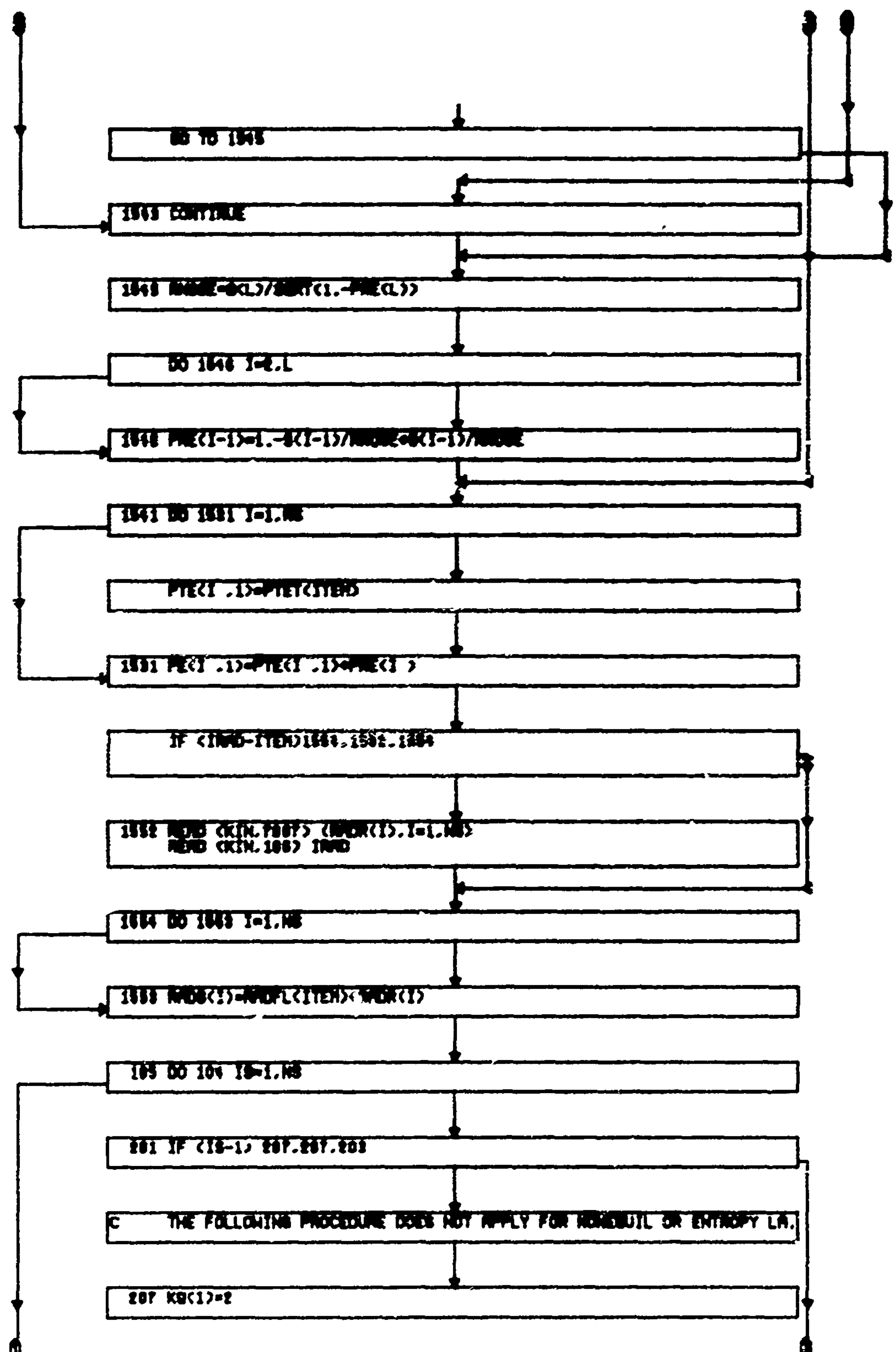
```
      WRITE(KOUT,16)(    S(I),I=1,NS)
      WRITE(KOUT,28)(ROKAP(I),I=1,NS)
      WRITE(KOUT,26)(   XI(I),I=1,NS)
      WRITE(KOUT,17)(  PRE(I),I=1,NS)
      WRITE(KOUT,25)( PE(I,1),I=1,NS)
      WRITE(KOUT,29)(   UE(I),I=1,NS)
      WRITE(KOUT,27)(BETAM(I),I=1,NS)
      WRITE(KOUT,32)( RADS(I),I=1,NS)
      WRITE(KOUT,18)( DSIP(I),I=1,NS)
C     CALCULATION OF C3 MATRIX
      DO 138 I=1,NS
      IF (KR(6)-1) 137,137,156
  137 IF (I-1) 139,139,158
  139 C3M(I)=-SQRT (BETAM(I)/(DUES*RHOE( I)*VMUE( I)))
      GO TO 138
  156 C3M(I)=-SQRT(2.*XI( I))/(RHOE( I)*ROKAP( I)*UE( I)*VMUE( I))
  138 CONTINUE
      WRITE(KOUT,33)(C3M(I),I=1,NS)
C     READ WALL CONDITIONS IF UNCOUPLED
      JRHOVW=0
      IF (ITEM-1) 108,108,7004
  108 IHW=1
      ITW=1
      IFW=1
      IRHOVW=1
      ISPW=1
      IFLUXJ=1
      DO 49 I=1,NS
      DO 49 L=1,3
   49 FLUXJ(L,I,1) = 0.
  107 IF (KR(9)-3) 7054,7005,1071
 1071 IF(KR(9)-5) 7047,7005,7047
 7054 IF(KR(11)-2) 7062,7040,7047
 7062 IF(KR(11)) 7004,7005,7004
 7004 IF (IHW-ITEM) 1091,109,1091
 1091 IF(   IHW-1) 1201,7005,1201
  109 READ(KIN,7007)((HW(J,JJ),JJ=1,NTIME),J=1,NS)
      READ (KIN,106) IHW
 1201 WRITE (KOUT,19)(HW(I,1),I=1,NS)
      IF (ITEM-1) 7038,7038,7060
 7005 IF (ITW-ITEM)1092,110,1092
 1092 IF(   ITW-1) 1202,7060,1202
  110 READ(KIN,7007)((TW(J,JJ),JJ=1,NTIME),J=1,NS)
      READ (KIN,106) ITW
 1202 WRITE (KOUT,20)(TW(I,1),I=1,NS)
      IF (ITEM-1) 117,117,7060
  117 IF (KR(9)-3) 7038,7047,7047
 7038 IF(KR(9)-1) 7060,7061,7040
 7060 IF (IFW-ITEM) 1093,112,1093
 1093 IF(   IFW-1) 1203,7061,1203
  112 READ(KIN,7007)((FW(J,JJ),JJ=1,NTIME),J=1,NS)
      READ (KIN,106) IFW
 1203 WRITE (KOUT,21)(FW(I,1),I=1,NS)
      GO TO 7006
 7061 IF (IRHOVW-ITEM) 1094,118,1094
 1094 IF(IRHOVW-1) 1204,7006,1204
  118 READ(KIN,7007)((RHOVW(J,JJ),JJ=1,NTIME),J=1,NS)
      READ (KIN,106) IRHOVW
      JRHOVW=1
 1204 IF(KR(8)-JRHOVW) 1102,1101,1101
```

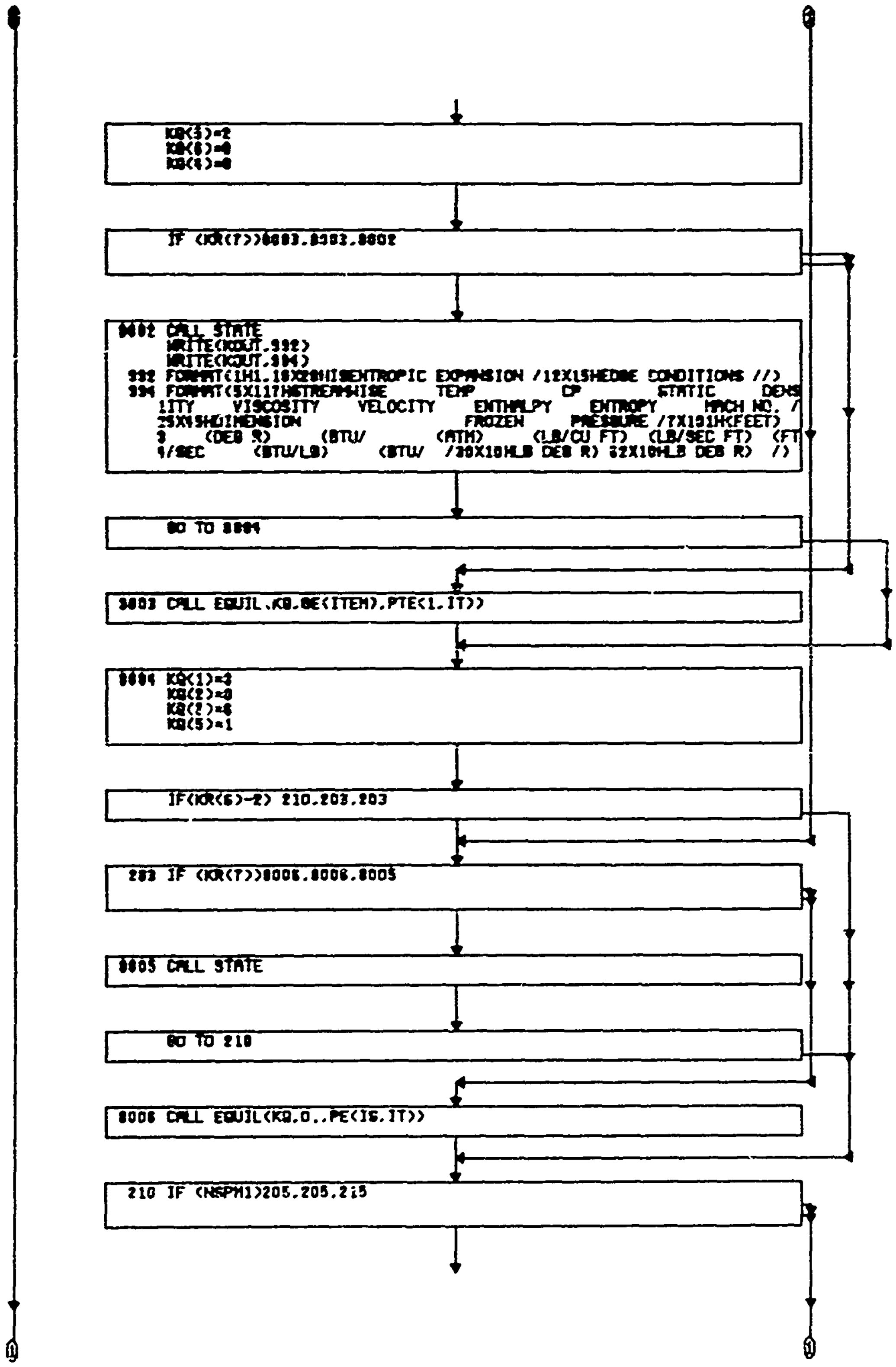
```
 1102 WRITE (KOUT,22)(RHOVW(I,1),I=1,NS)                              B07A 220
      GO TO 7006                                                      B07A 221
 1101 WRITE (KOUT,30)(RHOVW(I,1),I=1,NS)                              B07A 222
 7006 IF(NSPM1) 7043,7043,7015                                        B07A 223
 7015 IF (ISPW-ITEM) 1095,114,1095                                    B07A 224
 1095 IF(  ISPW-1) 1205,7040,1205
  114 DO 7014 K=1,NSPM1                                               B07A 225
 7014 READ(KIN,7007)((SPW(K,J,JJ),JJ=1,NTIME),J=1,NS)                 B07A 226
      READ (KIN,106) ISPW                                             B07A 227
 1205 DO 1097 K=1,NSPM1
 1097 WRITE (KOUT,23)( SPW(K,I,1),I=1,NS)                             B07A 229
      GO TO 7043                                                      B07A 230
 7040 IF (IFLUXJ-ITEM)1096,115,1096                                   B07A 231
 1096 IF(IFLUXJ-1) 1206,7043,1206
  115 DO 7041 K=1,3                                                   B07A 232
 7041 READ(KIN,7007) ((FLUXJ(K,J,JJ),JJ=1,NTIME),J=1,NS)              B07A 233
      READ (KIN,106) IFLUXJ                                           B07A 234
      JRHOVW=1
 1206 DO 1098 K=1,3
      IF(KR(8)-JRHOVW) 1104,1103,1103
 1104 WRITE (KOUT,24)(FLUXJ(K,I,1),I=1,NS)                            B07A 237
      DO 7039 J=1,NS
 7039 FLUXJ(K,J,1)=FLUXJ(K,J,1) * C3M(J)
      GO TO 1098                                                      B07A 238
 1103 WRITE (KOUT,31)(FLUXJ(K,I,1),I=1,NS)                            B07A 239
 1098 CONTINUE                                                        B07A 240
      GO TO 7047
 7043 IF(JRHOVW) 7047,7047,7045
C     CALCULATE FW IF RHOVW GIVEN                                     B07A 253
 7045 J=NDISC+1                                                       B07A 254
      DO 7046 II=1,J                                                  B07A 255
      K=NSD(II)                                                       B07A 256
      M=MSD(II)                                                       B07A 257
      LL=K+M-1                                                        B07A 258
      DO 209 I=M,LL                                                   B07A 259
      IF (KR(8)) 7049,7049,2291                                       B07A 260
 7049 RHOVW(I,IT)=RHOVW(I,IT)*C3M(I)                                  B07A 261
 2291 IF (II-1) 7048,7048, 230                                        B07A 262
 7048 IF (KR(6)) 229,229,230                                          B07A 263
C     VALID AT AXISYMETRIC STAGNATION POINT ONLY                      B07A 264
  229 FWCON(I)=-RHOVW(I,IT)/(2.*C3M(I))                               B07A 265
      IF( I-1) 209,209,232                                            B07A 266
C     MODIFICATION FOR AXISYMETRIC BLUNT AWAY FROM STAGNATION POINT   B07A 267
  232 FWCON( I)=FWCON( I)/S( I)*ROKAP( I)                             B07A 268
      GO TO 209                                                       B07A 269
C     VALID FOR ALL PLANAR                                            B07A 270
  230 FWCON(I)=-RHOVW(I,IT)/C3M(I)                                    B07A 271
      IF(KR(6)-2) 209,236,209                                         B07A 272
C     MODIFICATION FOR AXISYMETRIC SHARP                              B07A 273
  236 FWCON( I)=FWCON( I)/S( I)*ROKAP( I)/2.                          B07A 274
  209 FLUXJ(2,I,1)=RHOVW(I,1)
      FWDUM(1)=FWCON(1)*S(1)                                          B07A 276
      IF(KR(6)-2) 241,237,241                                         B07A 277
C     MODIFICATION FOR AXISYMETRIC SHARP                              B07A 278
  237 FWDUM(1)=FWDUM(1)*S(1)                                          B07A 279
  241 CONTINUE                                                        B07A 280
 7046 CALL SLOPQ(K,SDUM2(M),FWCON(M),DER(M),FWDUM(M))                 B07A 281
      DO 126 I =1,NS                                                  B07A 282
      IF(I -1) 124,124,123                                            B07A 283
  124 IF (KR(6)-1) 133,133,123                                        B07A 284
```

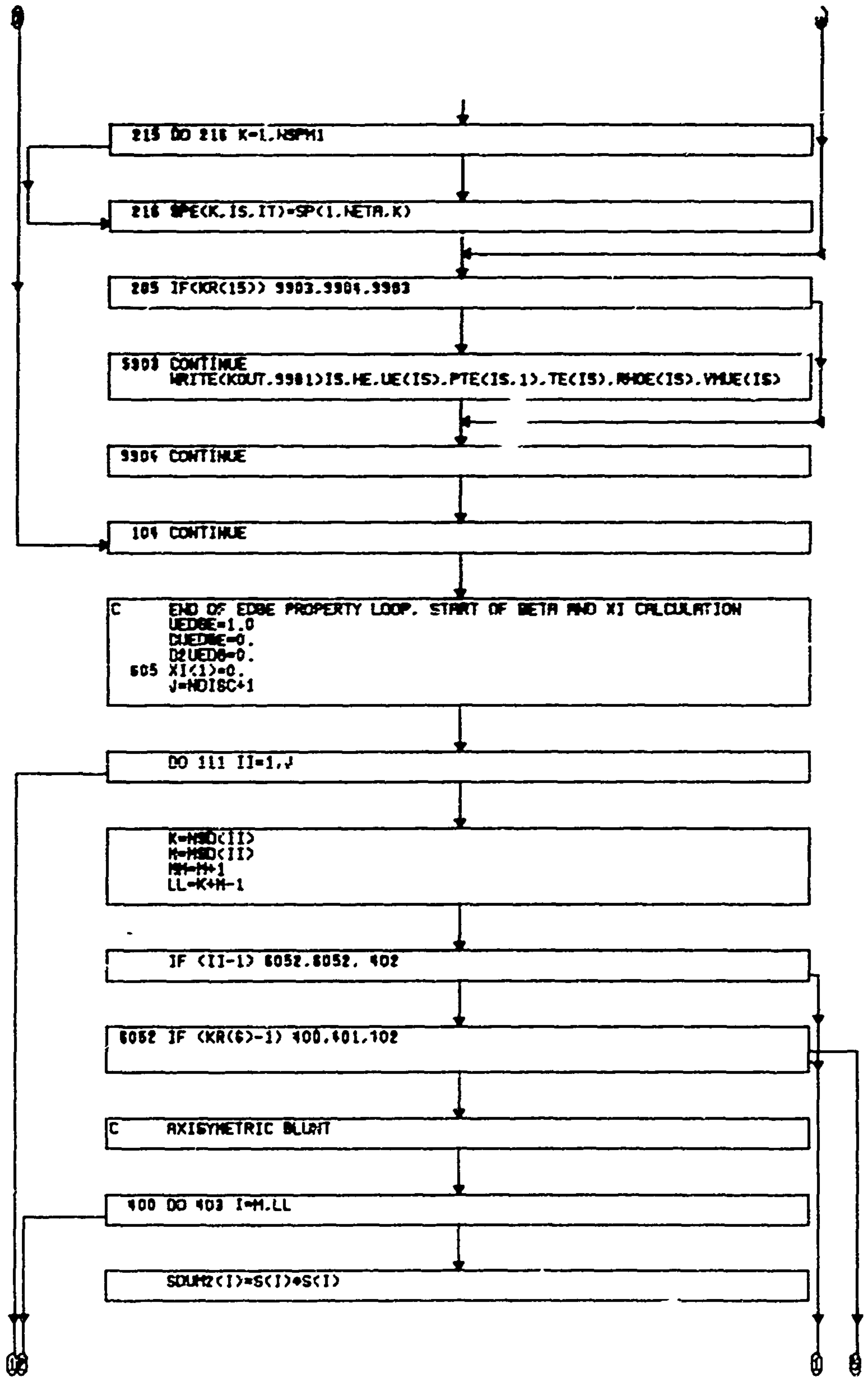
```
  133 IF (S(I)) 113,113,123                                  B07A 285
  113 FV(1,IT)=RHOVW(1,IT)                                   B07A 286
      GO TO 126                                              B07A 287
  123 FV(I ,IT)=FVDUM(I )/SQRT (2.*XI(I ))                   B07A 288
  126 CONTINUE                                               B07A 289
 7047 RETURN                                                 B07A 290
      END                                                    B07A 291
```

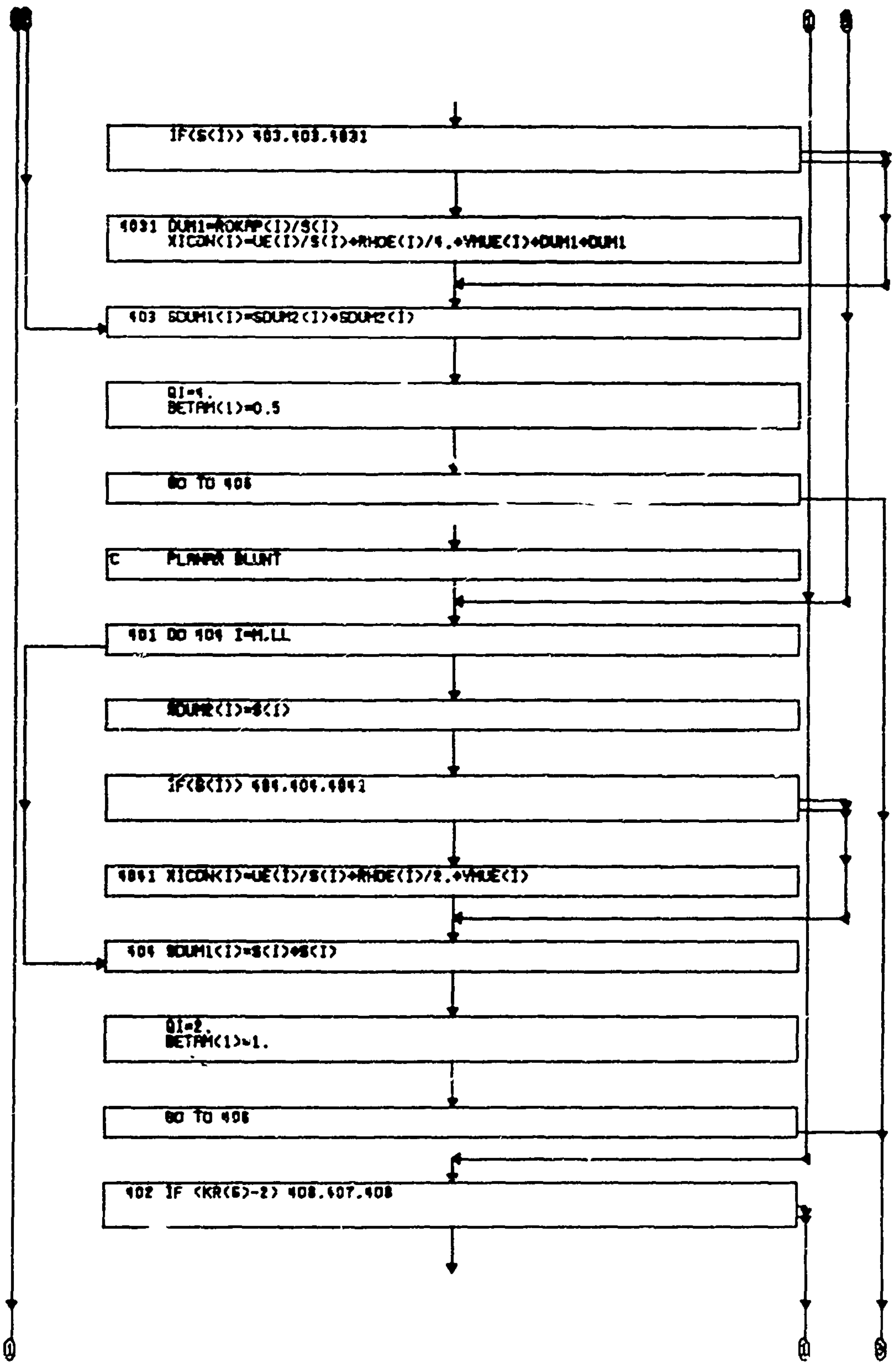
c. Flow Chart

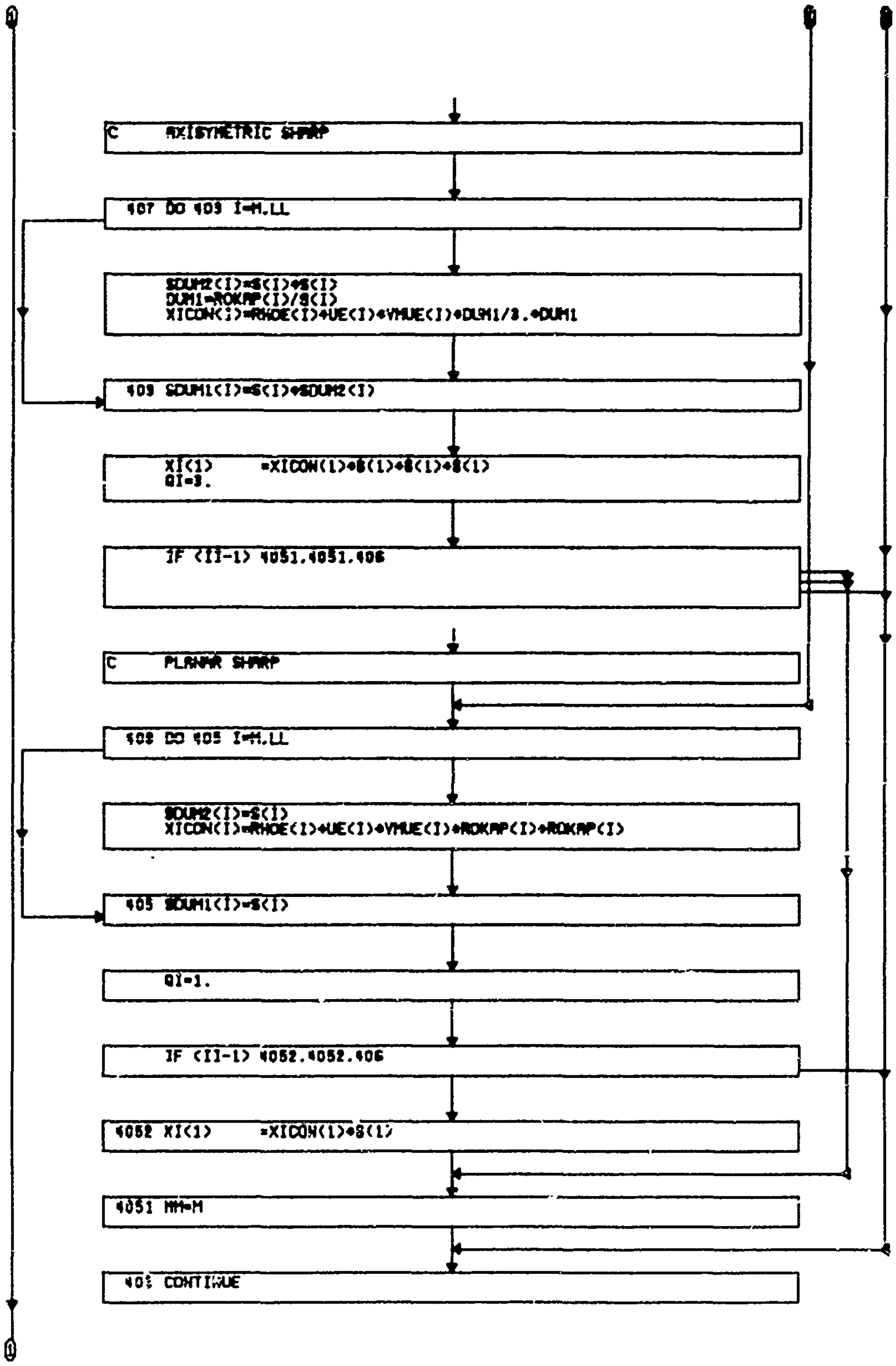

SUBROUTINE REFCON
IF (ITEM-1)
IDSIP=1
IPRE=1
DO 1540 I=1,NS
1540 DSIP(I)=0.
IF (IDSIP-ITEM)
READ (KIN,106) IDSIP
IF (IPRE-ITEM)
READ (KIN,106) IPRE
IF(PRE(1)) 1541,1542,1541
1542 DO 1543 I=2,NS
IF(PRE(I)) 1544,1543,1544
1544 L=I

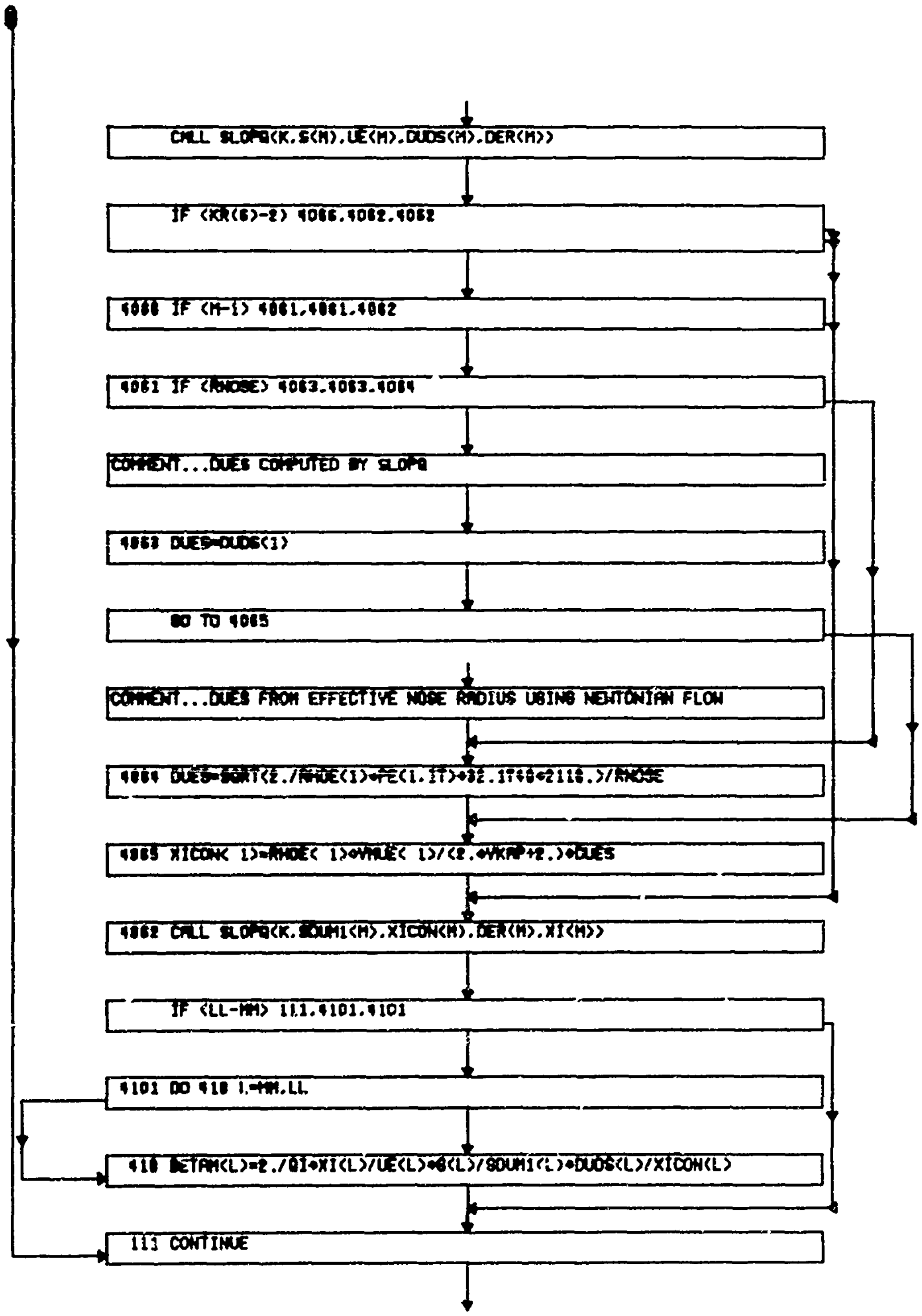

CONTINUE
105 DO 104 IS=1,NS
201 IF (IS-1) 207,207,203
C THE FOLLOWING PROCEDURE DOES NOT APPLY FOR NONEQUIL OR ENTROPY LA.
207 KS(1)=2


KR(3)=2
KR(6)=0
KR(4)=0
IF (KR(7))8003,8003,8002
8002 CALL STATE
WRITE(KOUT,992)
WRITE(KOUT,994)
992 FORMAT(1H1,18X26HISENTROPIC EXPANSION /12X15HEDGE CONDITIONS //)
994 FORMAT(5X117HSTREAMWISE TEMP CP STATIC DENS
1ITY VISCOSITY VELOCITY ENTHALPY ENTROPY MACH NO. /
25X9HDIMENSION FROZEN PRESSURE /7X131H(FEET)
3 (DEG R) (BTU/ (ATM) (LB/CU FT) (LB/SEC FT) (FT
4/SEC (BTU/LB) (BTU/ /30X10HLB DEG R) 32X10HLB DEG R) /)
GO TO 8004
8003 CALL EQUIL,KQ,BE(ITEM),PTE(1,IT))
8004 KQ(1)=3
KQ(2)=0
KQ(7)=6
KQ(5)=1
IF(KR(6)-2) 210,203,203
203 IF (KR(7))8006,8006,8005
8005 CALL STATE
GO TO 210
8006 CALL EQUIL(KQ,0.,PE(IS,IT))
210 IF (NSPM1)205,205,215

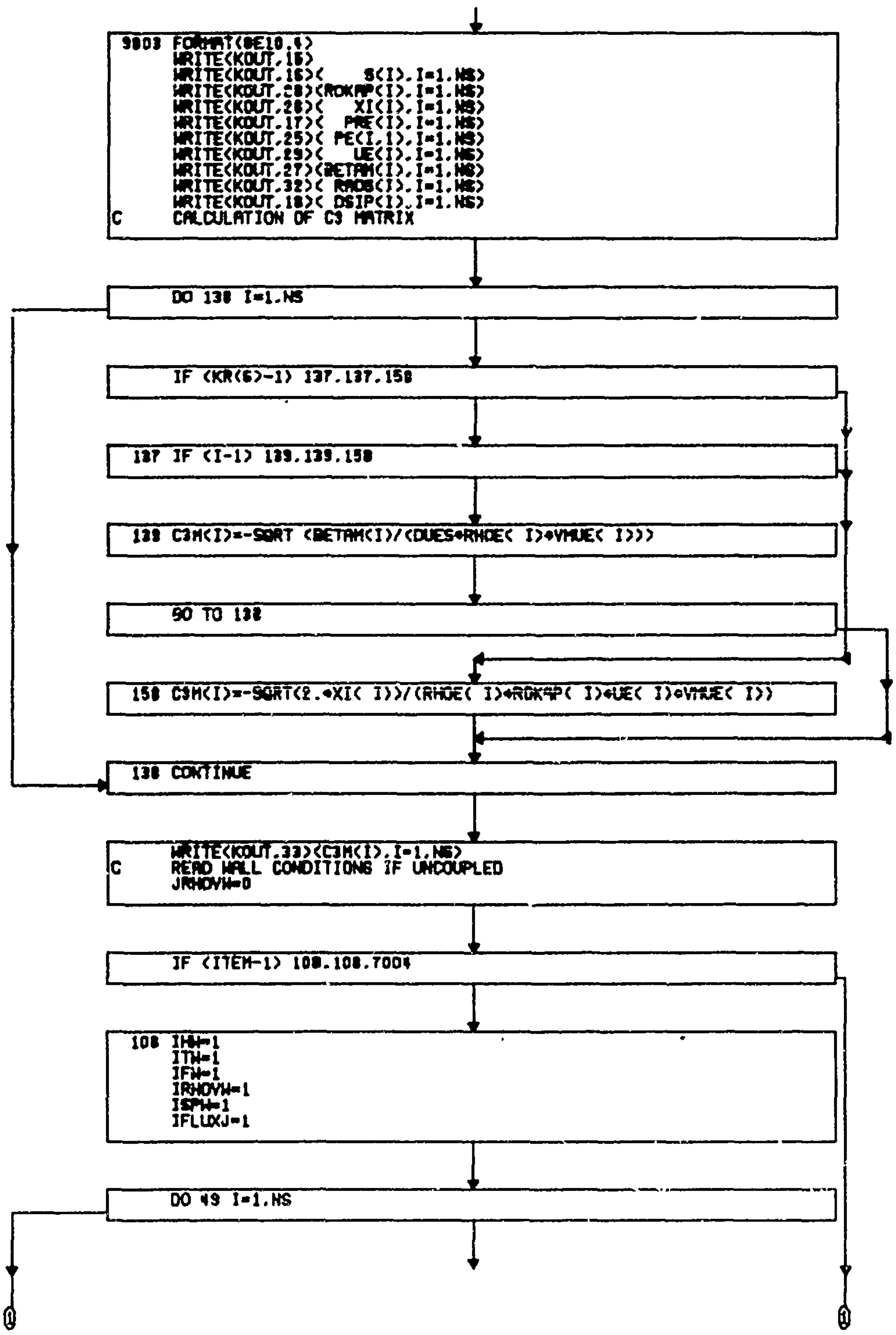

215 DO 216 K=1.NSPM1
216 SPE(K.IS.IT)=SP(1.NETA.K)
285 IF(KR(15)) 9903.9904.9903
9903 CONTINUE
WRITE(KOUT.9901)IS.HE.UE(IS).PTE(IS.1).TE(IS).RHOE(IS).VMUE(IS)
9904 CONTINUE
104 CONTINUE
C END OF EDGE PROPERTY LOOP. START OF BETA AND XI CALCULATION
UEDGE=1.0
DUEDXE=0.
D2UEDG=0.
605 XI(1)=0.
J=NDISC+1
DO 111 II=1,J
K=MSD(II)
M=MSD(II)
MM=M+1
LL=K+M-1
IF (II-1) 6052.6052, 402
6052 IF (KR(6)-1) 400.401,102
C AXISYMETRIC BLUNT
400 DO 403 I=M.LL
SDUM2(I)=S(I)*S(I)

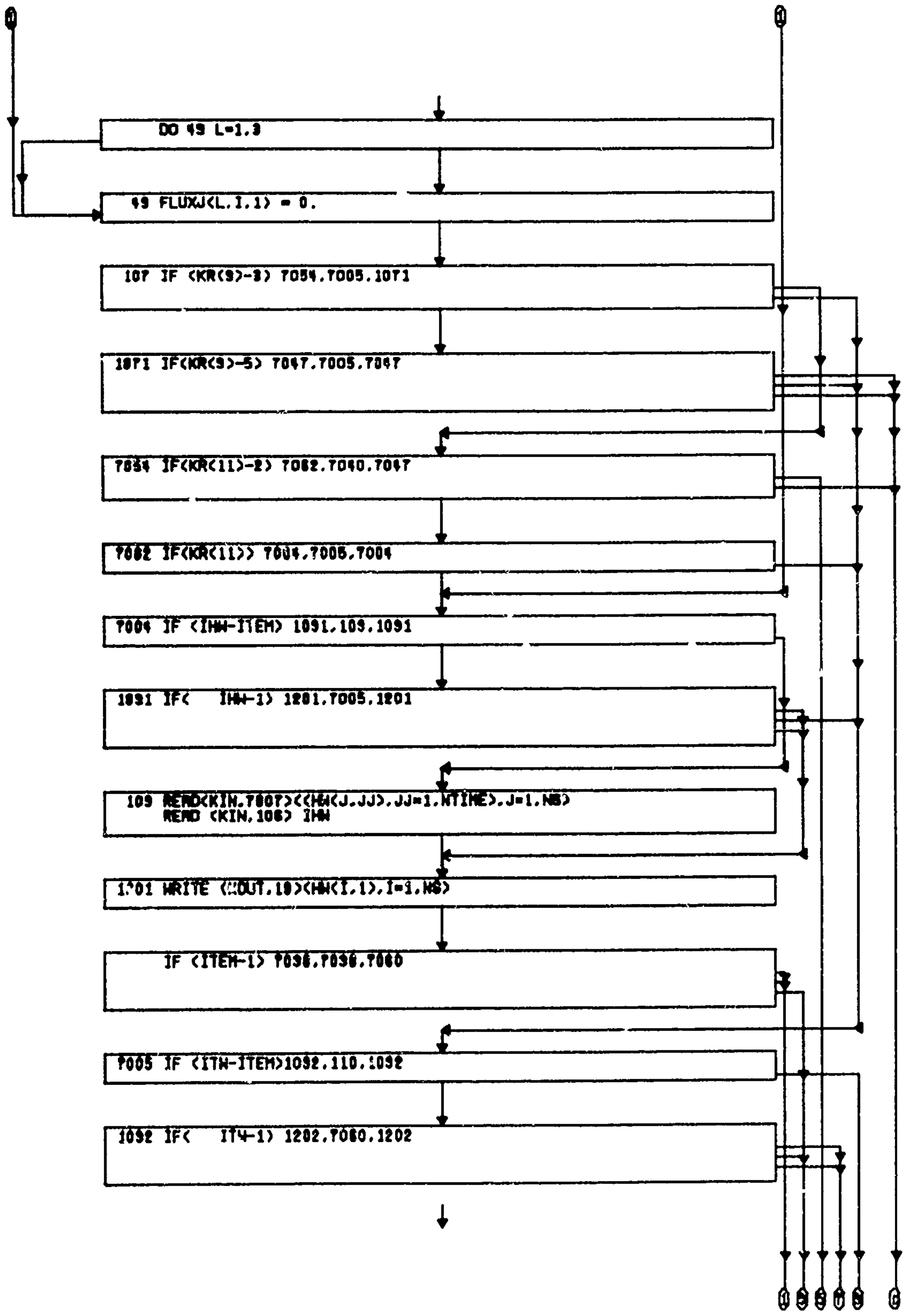

IF(S(I)) 403,403,4031
4031 DUM1=ROKAP(I)/S(I)
XICON(I)=UE(I)/S(I)*RHOE(I)/4.*VMUE(I)*DUM1*DUM1
403 SDUM1(I)=SDUM2(I)*SDUM2(I)
QI=4.
BETAM(1)=0.5
GO TO 406
C PLANAR BLUNT
401 DO 404 I=M,LL
SDUM2(I)=S(I)
IF(S(I)) 404,404,4041
4041 XICON(I)=UE(I)/S(I)*RHOE(I)/2.*VMUE(I)
404 SDUM1(I)=S(I)*S(I)
QI=2.
BETAM(1)=1.
GO TO 406
402 IF (KR(6)-2) 408,407,408

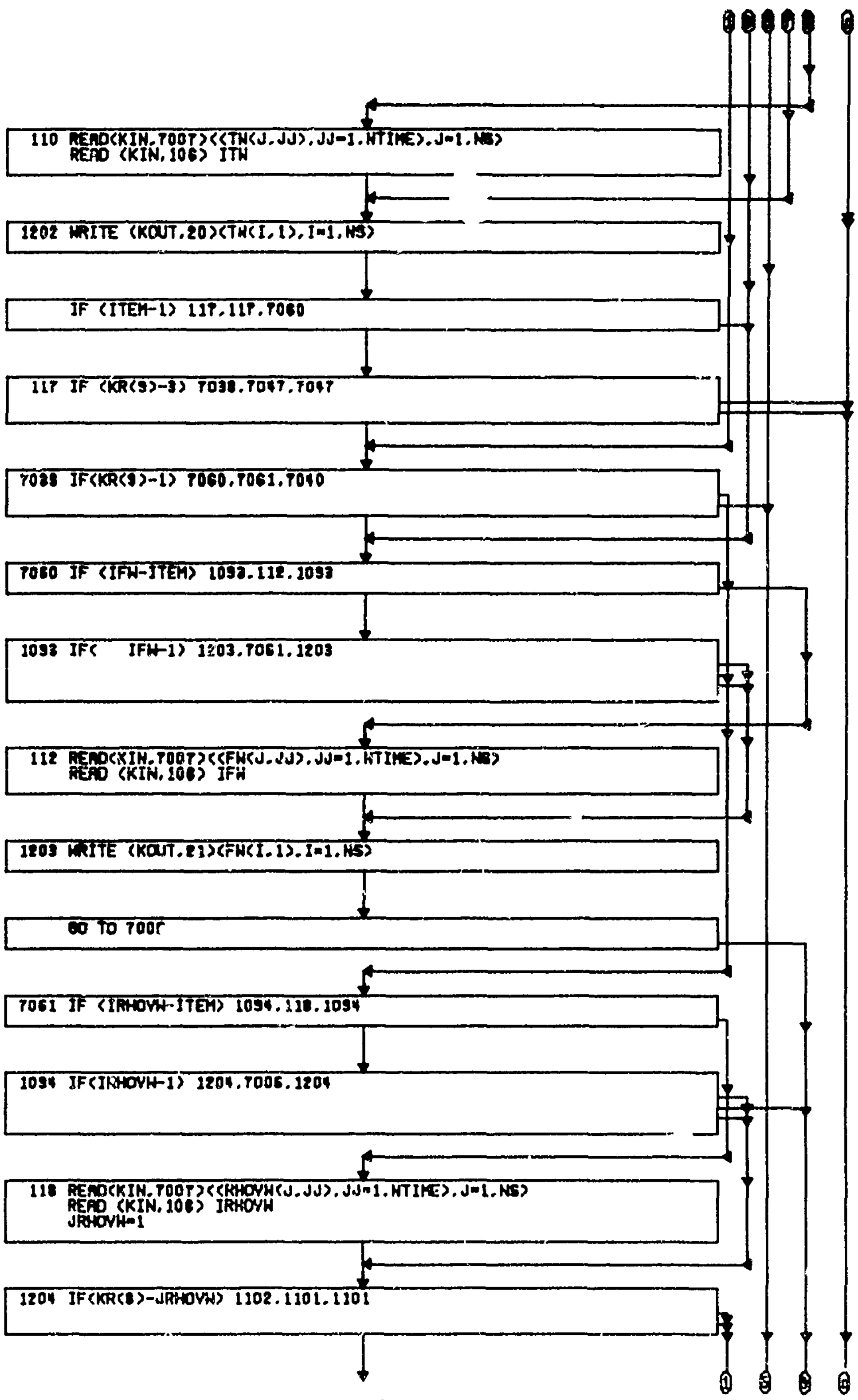

C AXISYMETRIC SHARP
407 DO 403 I=M,LL
SDUM2(I)=S(I)*S(I)
DUM1=ROKAP(I)/S(I)
XICON(I)=RHOE(I)*UE(I)*VMUE(I)*DUM1/3.*DUM1
403 SDUM1(I)=S(I)*SDUM2(I)
XI(1) =XICON(1)*S(1)*S(1)*S(1)
QI=3.
IF (II-1) 4051,4051,406
C PLANAR SHARP
408 DO 405 I=M,LL
SDUM2(I)=S(I)
XICON(I)=RHOE(I)*UE(I)*VMUE(I)*ROKAP(I)*ROKAP(I)
405 SDUM1(I)=S(I)
QI=1.
IF (II-1) 4052,4052,406
4052 XI(1) =XICON(1)*S(1)
4051 MM=M
403 CONTINUE



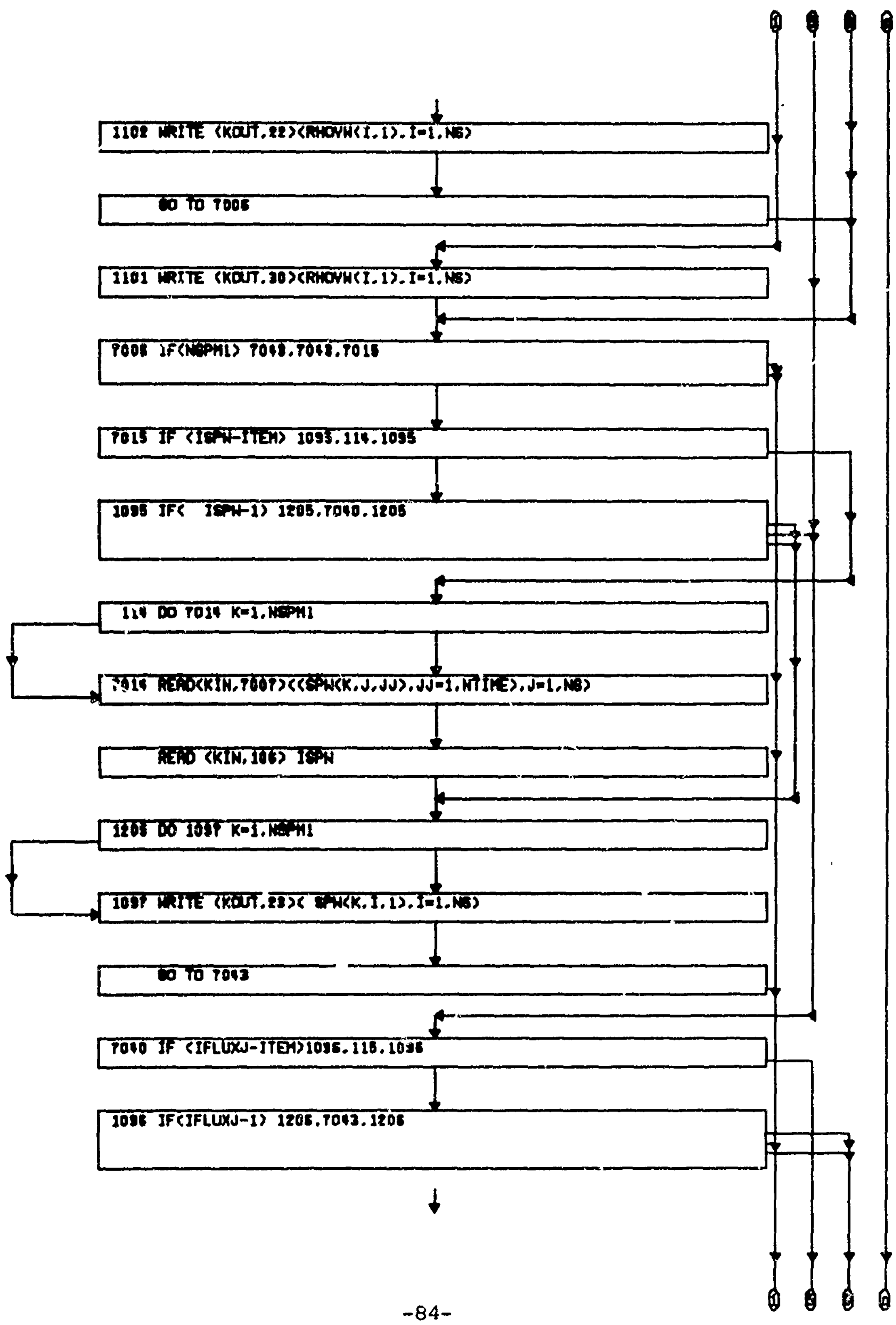
CALL SLOPQ(K,S(M),UE(M),DUDS(M),DER(M))
IF (KR(6)-2) 4066,4062,4062
4066 IF (M-1) 4061,4061,4062
4061 IF (RNOSE) 4063,4063,4064
COMMENT...DUES COMPUTED BY SLOPQ
4063 DUES=DUDS(1)
GO TO 4065
COMMENT...DUES FROM EFFECTIVE NOSE RADIUS USING NEWTONIAN FLOW
4064 DUES=SQRT(2./RHOE(1)*PE(1,IT)*32.174*2116.)/RNOSE
4065 XICON(1)=RHOE(1)*VMUE(1)/(2.*VKAP+2.)*DUES
4062 CALL SLOPQ(K,SOUM1(M),XICON(M),DER(M),XI(M))
IF (LL-MM) 111,4101,4101
4101 DO 410 L=MM,LL
410 BETAM(L)=2./QI*XI(L)/UE(L)*G(L)/SOUM1(L)*DUDS(L)/XICON(L)
111 CONTINUE

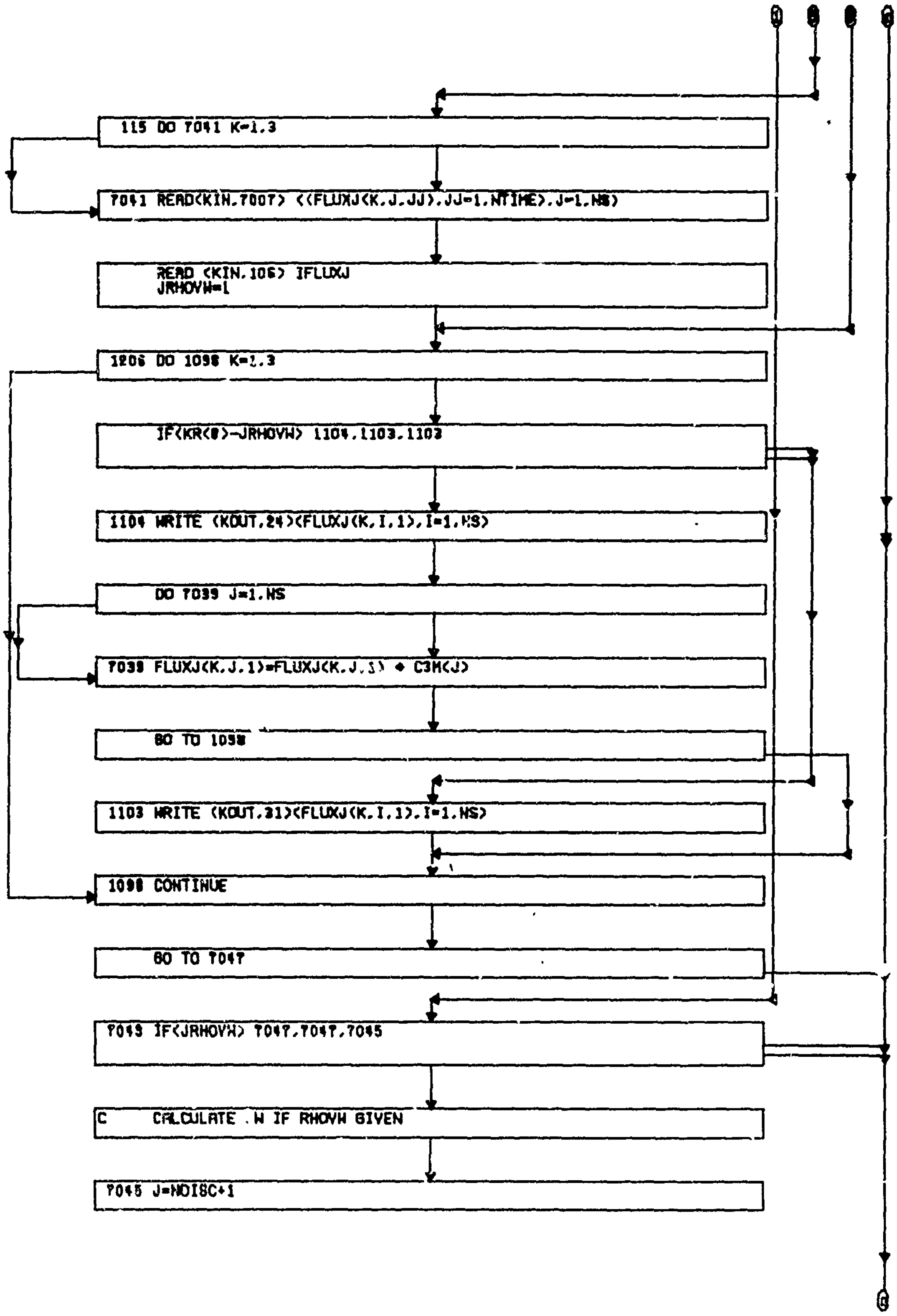

9003 FORMAT(8E10.4)
WRITE(KOUT,15)
WRITE(KOUT,16)(S(I),I=1,NS)
WRITE(KOUT,20)(ROKAP(I),I=1,NS)
WRITE(KOUT,26)(XI(I),I=1,NS)
WRITE(KOUT,17)(PRE(I),I=1,NS)
WRITE(KOUT,25)(PE(I,1),I=1,NS)
WRITE(KOUT,29)(UE(I),I=1,NS)
WRITE(KOUT,27)(BETAM(I),I=1,NS)
WRITE(KOUT,32)(RADS(I),I=1,NS)
WRITE(KOUT,18)(DSIP(I),I=1,NS)
C CALCULATION OF C3 MATRIX
DO 130 I=1,NS
IF (KR(6)-1) 137,137,150
137 IF (I-1) 139,139,150
139 C3M(I)=-SQRT (BETAM(I)/(DUES*RHOE(I)*VMUE(I)))
GO TO 130
150 C3M(I)=-SQRT(2.*XI(I))/(RHOE(I)*ROKAP(I)*UE(I)*VMUE(I))
130 CONTINUE
WRITE(KOUT,33)(C3M(I),I=1,NS)
C READ WALL CONDITIONS IF UNCOUPLED
JRHOVW=0
IF (ITEM-1) 100,100,7004
100 IHW=1
ITW=1
IFW=1
IRHOVW=1
ISPW=1
IFLUXJ=1
DO 49 I=1,NS
1
1

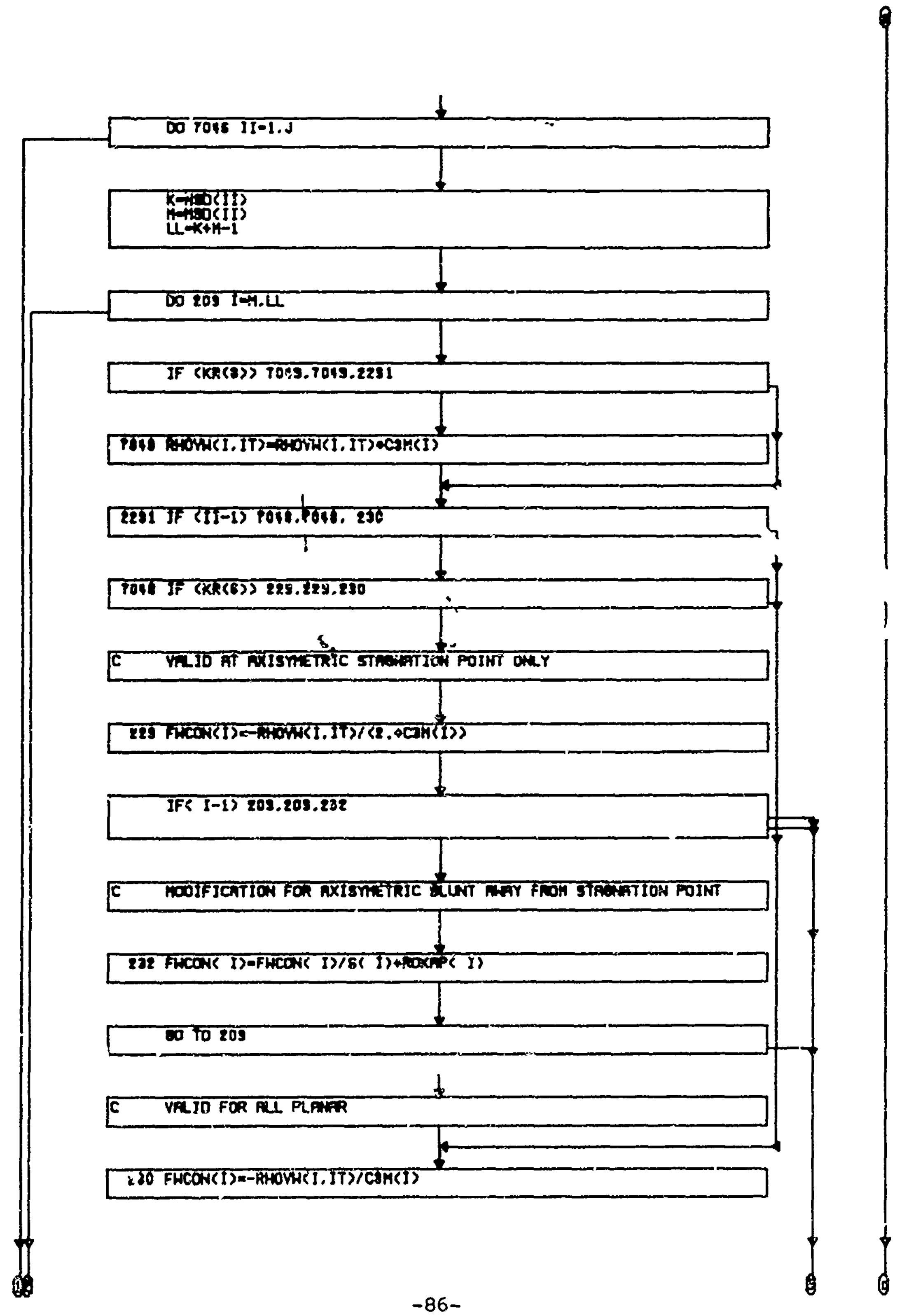

DO 49 L=1,3
49 FLUXJ(L,I,1) = 0.
107 IF (KR(9)-3) 7054,7005,1071
1071 IF(KR(9)-5) 7047,7005,7047
7054 IF(KR(11)-2) 7082,7040,7047
7082 IF(KR(11)) 7004,7005,7004
7004 IF (IHW-ITEM) 1091,109,1091
1091 IF(IHW-1) 1201,7005,1201
109 READ(KIN,7007)((HW(J,JJ),JJ=1,NTIME),J=1,NS)
READ (KIN,106) IHW
1201 WRITE (NOUT,10)(HW(I,1),I=1,NS)
IF (ITEM-1) 7030,7030,7060
7005 IF (ITW-ITEM)1092,110,1092
1092 IF(ITW-1) 1202,7060,1202

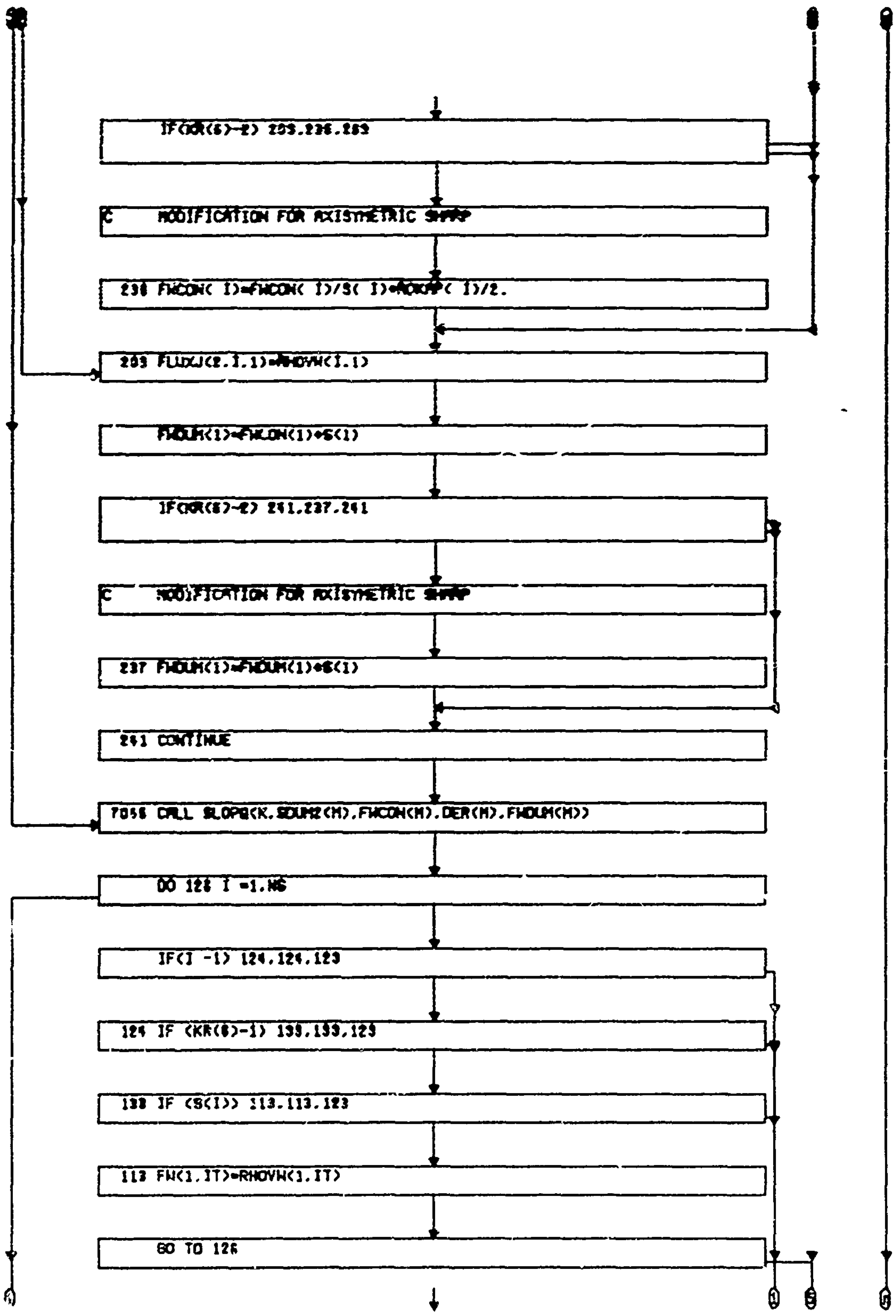


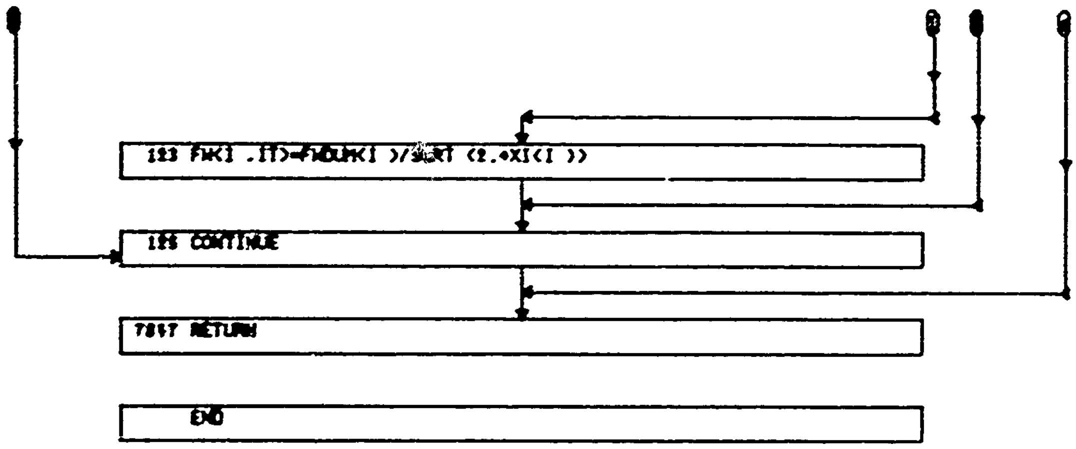
110 READ(KIN,7007)((TN(J,JJ),JJ=1,NTIME),J=1,NS)
READ (KIN,106) ITN
1202 WRITE (KOUT,20)(TN(I,1),I=1,NS)
IF (ITEM-1) 117,117,7060
117 IF (KR(9)-3) 7038,7047,7047
7038 IF(KR(9)-1) 7060,7061,7040
7060 IF (IFW-ITEM) 1093,112,1093
1093 IF(IFW-1) 1203,7061,1203
112 READ(KIN,7007)((FW(J,JJ),JJ=1,NTIME),J=1,NS)
READ (KIN,106) IFW
1203 WRITE (KOUT,21)(FW(I,1),I=1,NS)
GO TO 7007
7061 IF (IRHOVW-ITEM) 1094,118,1094
1094 IF(IRHOVW-1) 1204,7006,1204
118 READ(KIN,7007)((RHOVW(J,JJ),JJ=1,NTIME),J=1,NS)
READ (KIN,106) IRHOVW
JRHOVW=1
1204 IF(KR(8)-JRHOVW) 1102,1101,1101


1102 WRITE (KOUT.22)(RHOVH(I.1).I=1.NS)
GO TO 7006
1101 WRITE (KOUT.30)(RHOVH(I.1).I=1.NS)
7006 IF(NSPM1) 7043.7043.7015
7015 IF (ISPW-ITEM) 1095.114.1095
1095 IF(ISPW-1) 1205.7040.1205
114 DO 7014 K=1.NSPM1
7014 READ(KIN.7007)((SPW(K.J.JJ).JJ=1.NTIME).J=1.NS)
READ (KIN.106) ISPW
1205 DO 1097 K=1.NSPM1
1097 WRITE (KOUT.23)(SPW(K.I.1).I=1.NS)
GO TO 7043
7040 IF (IFLUXJ-ITEM)1096.115.1096
1096 IF(IFLUXJ-1) 1205.7043.1205


115 DO 7041 K=1,3
7041 READ(KIN,7007) ((FLUXJ(K,J,JJ),JJ=1,NTIME),J=1,NS)
READ (KIN,106) IFLUXJ
JRHOVW=1
1206 DO 1098 K=1,3
IF(KR(8)-JRHOVW) 1104,1103,1103
1104 WRITE (KOUT,24)(FLUXJ(K,I,1),I=1,NS)
DO 7039 J=1,NS
7039 FLUXJ(K,J,1)=FLUXJ(K,J,3) + C3W(J)
GO TO 1098
1103 WRITE (KOUT,31)(FLUXJ(K,I,1),I=1,NS)
1098 CONTINUE
GO TO 7047
7043 IF(JRHOVW) 7047,7047,7045
C CALCULATE W IF RHOVW GIVEN
7045 J=NDISC+1


DO 7046 II=1,J
K=MSD(II)
M=MSD(II)
LL=K+M-1
DO 209 I=M,LL
IF (KR(8)) 7049,7049,2291
7049 RHOVW(I,IT)=RHOVW(I,IT)*C3M(I)
2291 IF (II-1) 7048,7048, 230
7048 IF (KR(6)) 229,229,230
C VALID AT AXISYMETRIC STAGNATION POINT ONLY
229 FWCON(I)=-RHOVW(I,IT)/(2.*C3M(I))
IF(I-1) 209,209,232
C MODIFICATION FOR AXISYMETRIC BLUNT AWAY FROM STAGNATION POINT
232 FWCON(I)=FWCON(I)/S(I)+ROKAP(I)
GO TO 209
C VALID FOR ALL PLANAR
230 FWCON(I)=-RHOVW(I,IT)/C3M(I)


IF(KR(6)-2) 283,236,283
C MODIFICATION FOR AXISYMETRIC SHARP
236 FWCON(I)=FWCON(I)/S(I)+ROKMP(I)/2.
283 FLUXJ(2,I,1)=RHOVH(I,1)
FWDUM(1)=FWCON(1)+S(1)
IF(KR(6)-2) 241,237,241
C MODIFICATION FOR AXISYMETRIC SHARP
237 FWDUM(1)=FWDUM(1)+S(1)
241 CONTINUE
7056 CALL SLOPQ(K,SDUM2(M),FWCON(M),DER(M),FWDUM(M))
DO 126 I =1,NG
IF(I -1) 124,124,123
124 IF (KR(6)-1) 133,133,123
133 IF (S(I)) 113,113,123
113 FW(1,IT)=RHOVH(1,IT)
GO TO 126


123 FW(I ,IT)=FWDUM(I)/SQRT (2.*XI(I))
125 CONTINUE
7897 RETURN
END

8. SUBROUTINE ICOEFF - B08B

a. Function

Calculates groupings which contribute to the error equations and influence coefficients for the nonlinear (conservation) equations. Called by NONCER.

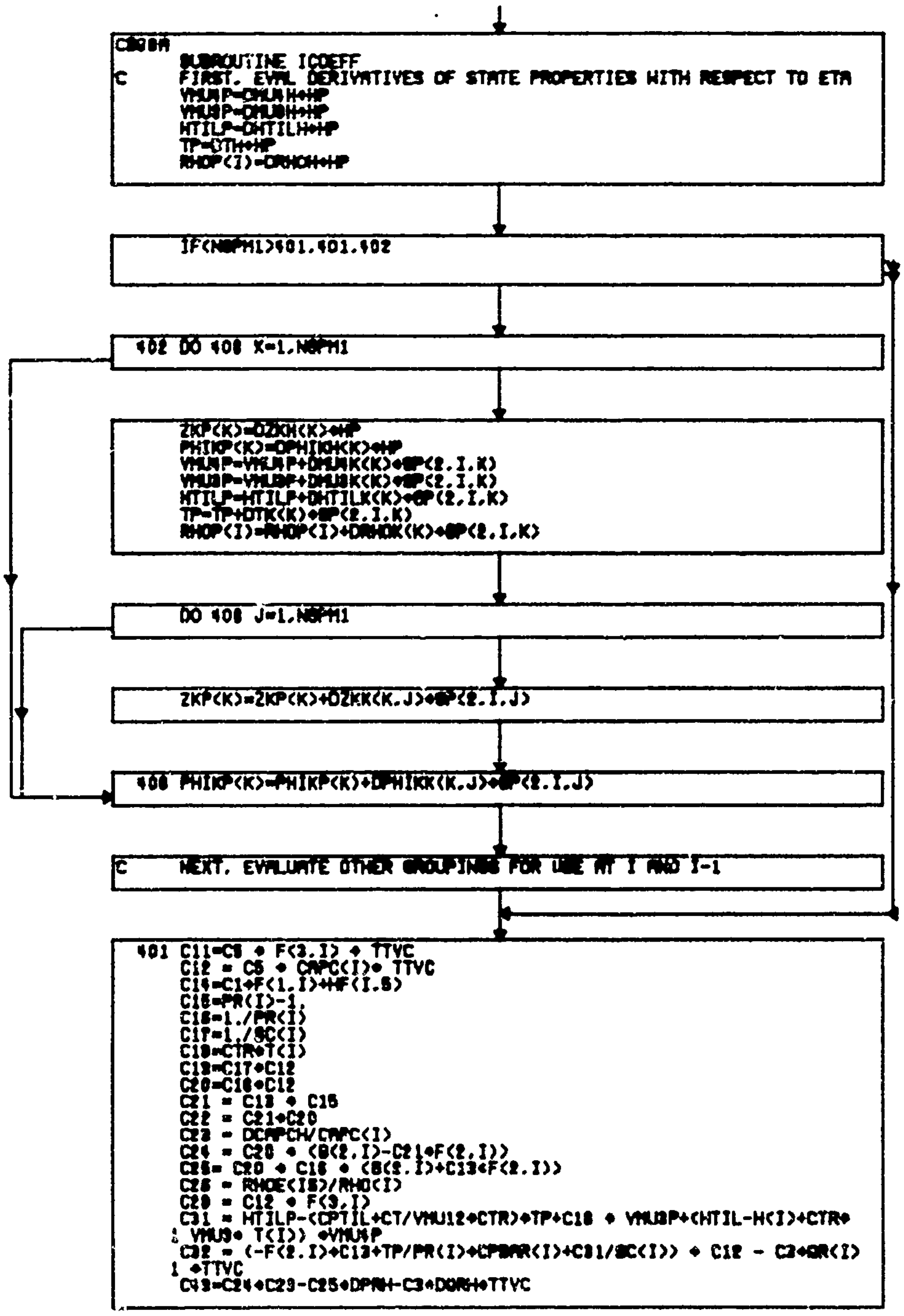
b. Listing

```
      CROPA                                                             B08A 001
            SUBROUTINE ICOEFF                                           B08A 002
            COMMON/COFCOM/               C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B08B   3*NEW
           1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB08B   4*NEW
           232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4B08B   5*NEW
           3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB08B   6*NEW
           465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81B08B   7*NEW
           5,C82,C83,C84,C85,C86,C87,C88                                B08B   8*NEW
            COMMON/CKECOM/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)  B08B   9*NEW
           1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)   B08B  10*NEW
           2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)  B08B  11*NEW
           3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9)  B08B  12*NEW
           4,CKK3( 8, 8)                                                B08B  13*NEW
            COMMON/EDGCOM/             PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B08B  14*NEW
           1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90  B08B  15*NEW
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                              B08B  16*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DS9(14),DCU(14),B1(14),B2(14)  B08B  17*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                             B08B  18*NEW
            COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8B08B  19*NEW
           1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B08B  20*NEW
           2,C3M(40),BETAM(40)                                          B08B  21*NEW
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB08B  22*NEW
           1S,IT,NTIME,NSP,NSPM1,NAP,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B08B  23*NEW
           2,R(8),       MWE,MON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B08B  24*NEW
           3,KAUXO,JTIME,JSPEC,MD(3)                                    B08B  25*NEW
            COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)  B08B  26*NEW
           1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB08B  27*NEW
           2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B08B  28*NEW
           3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)  B08B  29*NEW
           4,DPHIKK( 8, 8),       DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL  B08B  30*NEW
           5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B08B  31*NEW
           6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)  B08B  32*NEW
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH              B08B  33*NEW
      C     FIRST, EVAL DERIVATIVES OF STATE PROPERTIES WITH RESPECT TO ETA  B08A 028*-31
            VMU4P=DMU4H*HP                                              B08A 029
            VMU3P=DMU3H*HP                                              B08A 030
            HTILP=DHTILH*HP                                             B08A 031
            TP=DTH*HP                                                   B08A 032
            RHOP(I)=DRHOH*HP                                            B08A 033
            IF(NSPM1)401,401,402                                        B08A 034
        402 DO 408 K=1,NSPM1                                            B08A 035
            ZKP(K)=DZKH(K)*HP                                           B08A 036
            PHIKP(K)=DPHIKH(K)*HP                                       B08A 037
            VMU4P=VMU4P+DMU4K(K)*SP(2,I,K)                              B08A 038
            VMU3P=VMU3P+DMU3K(K)*SP(2,I,K)                              B08A 039
            HTILP=HTILP+DHTILK(K)*SP(2,I,K)                             B08A 040
            TP=TP+DTK(K)*SP(2,I,K)                                      B08A 041
            RHOP(I)=RHOP(I)+DRHOK(K)*SP(2,I,K)                          B08A 042
            DO 408 J=1,NSPM1                                            B08A 043
            ZKP(K)=ZKP(K)+DZKK(K,J)*SP(2,I,J)                           B08A 044
        408 PHIKP(K)=PHIKP(K)+DPHIKK(K,J)*SP(2,I,J)                     B08A 045
      C     NEXT, EVALUATE OTHER GROUPINGS FOR USE AT I AND I-1         B08A 046
        401 C11=C5 * F(3,I) * TTVC
            C12 = C5 * CAPC(I)* TTVC
            C14=C1*F(1,I)+HF(I,5)                                       B08A 049
            C15=PR(I)-1.                                                B08A 050
            C16=1./PR(I)                                                B08A 051
            C17=1./SC(I)                                                B08A 052
```

```
      C18=CTR*T(I)                                                      B08A 053
      C19=C17*C12                                                       B08A 054
      C20=C16*C12                                                       B08A 055
      C21 = C13 * C15
      C22 = C21*C20
      C23 = DCAPCH/CAPC(I)
      C24 = C20 * (G(2,I)-C21*F(2,I))
      C25= C20 * C16 * (G(2,I)+C13*F(2,I))
      C26 = RHOF(IS)/RHO(I)
      C28 = C12 * F(3,I)
      C31 = HTILP-(CPTIL+CT/VMU12*CTR)*TP+C18 * VMU3P+(HTIL-H(I)+CTR*
     1 VMU3* T(I)) *VMU4P
      C32 = (-F(2,I)*C13+TP/PR(I)*CPBAR(I)+C31/SC(I)) * C12 - C3*QR(I)
     1 *TTVC
      C43=C24*C23-C25*DPRH-C3*DQRH*TTVC
      C53=RHOP(I)/RHO(I)
      C56 = F(2,I)/ALPH
      C73 = C1 * F(2,I)
      C74 = C11 * C10 * DCAPCH + C14
      C75=C11*DCAPCH                                                    B08A 100
      C76=C1*G(1,I)                                                     B08A 101
      C77=-C22+C43*C10
      C78=-C20*C15*C10
      C79=C43
      C80=C20
      C81=-C28*(C10*C56*C23+C5)
      C82=-C20*C5*G(2,I)+3.0*C22*C56-C43*C10*C56
      C83=C28+C14 * F(2,I)
  412 C84=C32+G(1,I)*C14                                                B08A 109
      C85 = -C6/RHO(I)-C26/2.
      C86=C85*C10*DRHOH
      C87=BETA*ALPH*C26-C86*C56
      C88=C85*DRHOH
      DUM1=C23-DSCH/SC(I)
      IF(NSPM1)403,403,404                                              B08A 110
  404 DO 406 K=1,NSPM1
      CK3(K) = DCAPCK(K)/CAPC(I)
  406 CK4(K)=CK3(K)-DSCK(K)/SC(I)
      DO 410 K=1,NSPM1
      DUM2=C19 * SP(2,I,K)
      CK1(K)=C24*CK3(K)-C25*DPRK(K)-C3*DQRK(K)*TTVC
      CK2(K)=0.
      CK5(K)=0.
      DUM3=ZK(K)-SP(1,I,K)
      CK6(K)=C19*(ZKP(K)+VMU4P*DUM3)
      CK9(K)= DUM2*DUM1
      CK13(K)=C85*DRHOK(K)
      CK14(K)=0.
      CK15(K)=0.
      CK16(K)=0.
      CK17(K)=C11*DCAPCK(K)                                             B08A 125
      CK18(K)=C1*SP(1,I,K)                                              B08A 126
      CK19(K)=CK9(K)*C10
      CK20(K)=0.
      CK21(K)=-CK19(K)*C56-DUM2/ALPH
  414 CK22(K)=CK6(K)+SP(1,I,K)*C14                                      B08A 130
      DO 410 KK=1,NSPM1                                                 B08A 131
      CKK1(K,KK)=C19*(DZKK(K,KK)+DUM3*DMU4K(KK))
      CKK3(K,KK)=DPHIKK(K,KK)
  410 CKK2(K,KK)=DUM2*CK4(KK)
```

```
000119        403 CONTINUE                                    BOBA 135
000120            RETURN                                      BOBA 136
000121            END                                         BOBA 137
```

c. Flow Chart


C0000
SUBROUTINE ICOEFF
C FIRST, EVAL DERIVATIVES OF STATE PROPERTIES WITH RESPECT TO ETA
VMU1P=DMU1H*HP
VMU2P=DMU2H*HP
HTILP=DHTILH*HP
TP=DTH*HP
RHOP(I)=DRHOH*HP
IF(NSPM1)401,401,402
402 DO 408 K=1,NSPM1
ZKP(K)=DZKH(K)*HP
PHIKP(K)=DPHIKH(K)*HP
VMU1P=VMU1P+DMU1K(K)*SP(2,I,K)
VMU2P=VMU2P+DMU2K(K)*SP(2,I,K)
HTILP=HTILP+DHTILK(K)*SP(2,I,K)
TP=TP+DTK(K)*SP(2,I,K)
RHOP(I)=RHOP(I)+DRHOK(K)*SP(2,I,K)
DO 408 J=1,NSPM1
ZKP(K)=ZKP(K)+DZKK(K,J)*SP(2,I,J)
408 PHIKP(K)=PHIKP(K)+DPHIKK(K,J)*SP(2,I,J)
C NEXT, EVALUATE OTHER GROUPINGS FOR USE AT I AND I-1
401 C11=C8 * F(3,I) * TTVC
C12 = C5 * CAPC(I)* TTVC
C14=C1*F(1,I)*HF(I,5)
C15=PR(I)-1.
C16=1./PR(I)
C17=1./SC(I)
C18=CTR*T(I)
C19=C17*C12
C20=C16*C12
C21 = C19 * C15
C22 = C21*C20
C23 = DCAPCH/CAPC(I)
C24 = C20 * (B(2,I)-C21*F(2,I))
C25= C20 * C16 * (B(2,I)+C13*F(2,I))
C26 = RHOE(IS)/RHO(I)
C29 = C12 * F(3,I)
C31 = HTILP-(CPTIL+CT/VMU12*CTR)*TP+C18 * VMU2P+(HTIL-H(I)+CTR*
1 VMU3* T(I)) *VMU1P
C32 = (-F(2,I)*C13+TP/PR(I)+CPBAR(I)+C31/SC(I)) * C12 - C3*QR(I)
1 *TTVC
C43=C24*C29-C25*DPRH-C3*DQRH*TTVC

```
      C53=RHOP(I)/RHO(I)
      C66 = F(2,I)/ALPH
      C73 = C1 * F(2.I)
      C74 = C11 * C10 * DCAPCH + C14
      C75=C11*DCAPCH
      C76=C1*G(1.I)
      C77=-C22+C43*C18
      C78=-C20*C15*C18
      C79=C43
      C80=C20
      C81=-C28*(C18*C56*C23+C8)
      C82=-C20*C5*G(2,I)+3.0*C22*C56-C43*C10*C58
      C83=C28+C14 * F(2.I)
  412 C84=C82+G(1.I)*C14
      C85 = -C8/RHO(I)+C26/2.
      C86=C85*C18*DRHOH
      C87=BETA*ALPH*C26-C86*C56
      C88=C85*DRHOH
      DUM1=C23-DSCH/SC(I)
```

```
      IF(NSPM1)403.403.404
```

```
  404 DO 408 K=1.NSPM1
```

```
      CK8(K) = DCAPCK(K)/CAPC(I)
```

```
  408 CK4(K)=CK8(K)-DSCK(K)/SC(I)
```

```
      DO 410 K=1.NSPM1
```

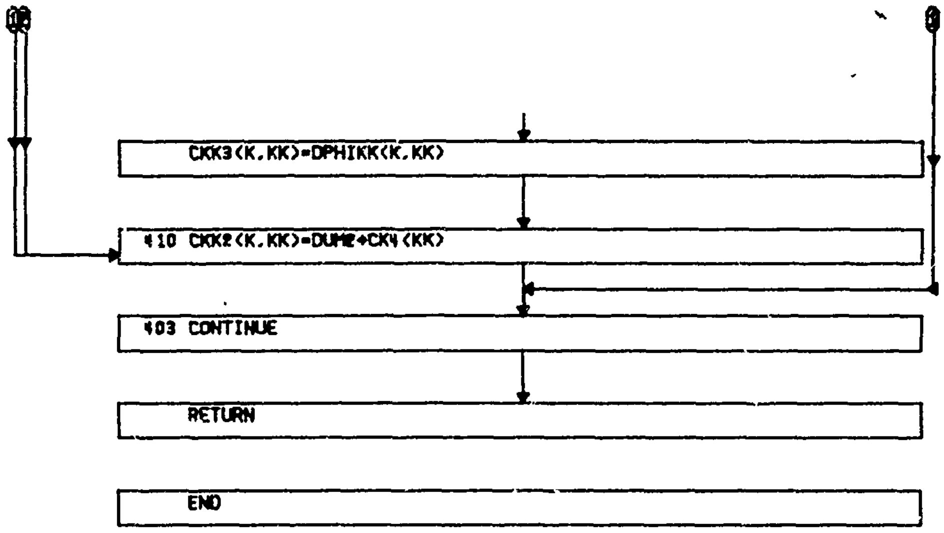
```
      DUM2=C13 + SP(2.I.K)
      CK1(K)=C24*CK8(K)-C26*DPRK(K)-C8*DC2K(K)*TTVC
      CK2(K)=0.
      CK5(K)=0.
      DUM3=ZK(K)-SP(1.I.K)
      CK6(K)=C13*(ZKP(K)+VHU4P*DUM3)
      CK9(K)= DUM2*DUM1
      CK13(K)=C85*DRHOK(K)
      CK14(K)=0.
      CK15(K)=0.
      CK16(K)=0.
      CK17(K)=C11*DCAPCK(K)
      CK18(K)=C1*SP(1.I.K)
      CK19(K)=CK9(K)*C10
      CK20(K)=0.
      CK21(K)=-CK19(K)*C56-DUM2/ALPH
  414 CK22(K)=CK6(K)+SP(1.I.K)*C14
```

```
      DO 410 KK=1.NSPM1
```

```
      CKK1(K.KK)=C13*(DZKK(K.KK)+DUM3*DHU4K(KK))
```

10

6


CKK3(K,KK)=DPHIKK(K,KK)
410 CKK2(K,KK)=DUM2*CK4(KK)
403 CONTINUE
RETURN
END

9. SUBROUTINE RECASE - B09A

a. Function

Reads in most of boundary layer input data. Called by SETUP.

b. Listing

```
      CH09A                                                             B09A 001
            SUBROUTINE RECASE                                           B09A 002
            COMMON/CRBCOM/HCARB,EMIS,STEF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMISTB09A   3*NEW
           1,HPG,ASU(3),BSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(40),ISU      B09A   4*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14) B09A   5*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                             B09A   6*NEW
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB09A   7*NEW
           1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B09A   8*NEW
           2,R(8),       MFE,MON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B09A   9*NEW
           3,MAUXO,JTIME,JSPEC,MD(3)                                    B09A  10*NEW
            COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B09A  11*NEW
           1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO, B09A  12*NEW
           2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                      B09A  13*NEW
          1 FORMAT(20I1,15A4)                                           B09A 016*-14
          2 FORMAT(I2)                                                  B09A 017
          3 FORMAT(I2/(8E10.4))                                         B09A 018
          4 FORMAT(1H114X56HBOUNDARY LAYER INTEGRAL MATRIX PROGRAM (BLIMP)   B09A 019
           1       //8X47HAEROTHERM CORPORATION,PALO ALTO,CALIF (RMK,EPB)   B09A 020
           1,2X3A6  //1X,                                            5H
           2CASE ,15A4,//,8X,75HCONTROL NUMBERS  1  2  3  4  5  6  7  8  9 10 B09A 022
           311 12 13 14 15 16 17 18 19 20,//,23X,20I3//8X14HPUNCH CONTROL  /8X
           412HIDENT  JSPEC/10XA2,7XI2/)
          5 FORMAT(8F10.4)                                              B09A 026
          6 FORMAT(I2,E10.4)                                            B09A 027
          7 FORMAT(/9X20HVISCOSITY LAW   MU (E10.3,4H*T**E10.3,3H)/(E10.3,3H*TB09A 028
           .1+E10.3,1H)//9X19HENTHALPY LAW    T=E10.3,1H+E10.3,4H*H**E10.3,1H+B09A 029
           2/42X2H((E10.3,7H+1.)*H/E10.3,8H)**(1./(E10.3, 5H+1.))//9X19HPRANDTB09A 030
           3L NUMBER  PR=E10.3,1H+E10.3,4H*T**E10.3,1H+E10.3,4H*T**E10.3/)   B09A 031
          9 FORMAT(21I1)                                                B09A 032
         10 FORMAT   (/,10X70HU/UE TO  NODAL PT.    GAMMA   MOLECULAR   B09A 033
           1                    /9X18HNORM. ETA AT WHICH13X40HWEIGHT    B09A 034
           2                             /19X9HETA NORM.)               B09A 035
          8 FORMAT(3X1PE10.3,9XI2,6X9E10.3/(30X9E10.3))
         11 FORMAT    (/,5X70HU/UE TO       NODAL PT.                   B09A 037
           1      ETA VALUES       /4X23HNORM. ETA       AT WHICH       B09A 038
           2                             /19X9HETA NORM.)               B09A 039
         12 FORMAT (/2X,15HNOSE RADIUS,FT ,1PE12.5,5X,16HCONE HALF ANGLE ,1PE1B09A 040
           12.5,8H DEGREES)                                             B09A 041
         13 FORMAT (/,1X,23HTIME,SEC                ,1P8E12.5/(24X,1P8E12.5))  B09A 042
         14 FORMAT (/,1X,23HTOTAL ENTHALPY,BTU/LB   ,1P8E12.5/(24X,1P8E12.5))  B09A 043
         18 FORMAT (/,1X,23HCASE                    ,1P8E12.5/(24X,1P8E12.5))
         15 FORMAT (/,1X,23HTOTAL PRESSURE,ATM      ,1P8E12.5/(24X,1P8E12.5))  B09A 044
         16 FORMAT(A2,I2,I6)
         17 FORMAT (/,1X,23HINCIDENT RAD FLUX,B/SF2,1P8E12.5/(24X,1P8E12.5))
         20 FORMAT(/,1X,56HSURFACE RECESSION - WALL TEMPERATURE RELATION FOR T
           1EFLON//5X,43HSURFACE RECESSION RATE, LB/SEC FT2 = EXP(((,1P E12.5,
           26H)*TW+(,1P E12.5,7H))*TW+(,1P E12.5,2H)),//5X,37HWHERE TW IS WALL
           3 TEMPERATURE IN DEG R)
C           NOTE...KR(5)=4 FOR EQUIL,3 FOR EQUIL WITH ENTROPY LAYER, 1     B09A 046
C           FOR NONEQUIL, AND 2 FOR NONEQUIL WITH ENTROPY LAYER...ROKAP=1 FOR B09A 047
C           PLANAR..(KR(6)=1 AND 3 FOR BLUNT AND SHARP, RESP) AND IS EQUAL TO B09A 048
C           DISTANCE FROM AXIS OF SYMMETRY TO BODY SURFACE FOR AXISYM..    B09A 049
C           (KR(6)=0 AND 2 FOR BLUNT AND SHARP, RESPECTIVELY)... KR(7)=0 FOR  B09A 050
C           MULTICOMPONENT B.L. AND=1 FOR HOMOGENEOUS B.L..IDISC=0 FOR NO    B09A 051
C           DISCONTINUITY AND UNITY FOR DISC. IN ROKAP,FW, OR RHOWVW        B09A 052
            DATA MD(2)/6H      /
            CALL DATE (9,MD)
            CALL TOD ( 18, MD)
```

```
      READ(KIN,1)KR,CASE                                                B09A 053
      READ(KIN,16) IDENT,JSPEC,JTIME
      WRITE(KOUT,4) MD,CASE,KR,IDENT,JSPEC
      KR(9)=0
      IF(KR(6)-8) 245,240,245
  240 KR(9)=-1
      KR(6)=4
      GO TO 255
  245 IF(KR(6)-4) 255,255,250
  250 KR(9)=1
      KR(6)=KR(6)-5
  255 READ(KIN,24) NSP,KS
   24 FORMAT(I2,8X70I1)
      NSPM1=NSP-1                                                       B09A 057
      READ (KIN,3) NTIME,(TIME(IT),IT=1,NTIME)                          B09A 058
      NITEM=NTIME                                                       B09A 059
      NTIME=1                                                           B09A 060
      READ(KIN,24) NS,KR9
      READ(KIN,5)(S(IS),IS=1,NS)
      KAUXO=1                                                           RDG
      IF(KR (14)-2) 303,303,302                                         RDG
  302 KAUXO=KR (14)-1                                                   RDG
      KR (14)=KR (14)-3                                                 RDG
C     COMPUTE INFORMATION NEEDED TO CONSIDER DISCONTINUITIES            B09A 062
  303 J=1                                                               B09A 063
  102 MSD(1)=1                                                          B09A 064
      IDISC(1)=1
      S(1)=ABS(S(1))                                                    B09A 066
      IF (NS-1) 105,105,1021                                            B09A 067
 1021 DO 101 IS=2,NS                                                    B09A 068
      IDISC(IS)=0                                                       B09A 069
      IF(S(IS)) 103,101,101                                             B09A 070
  103 NSD(J)=IS-MSD(J)+1                                                B09A 071
      S(IS)=-S(IS)                                                      B09A 072
      IDISC(IS)=1                                                       B09A 073
      J=J+1                                                             B09A 074
      MSD(J)=IS                                                         B09A 075
  101 CONTINUE                                                          B09A 076
  105 NSD(J)=NS-MSD(J)+1                                                B09A 077
      NDISC=J-1                                                         B09A 078
      IF (KR(1)) 1051,1051,1052                                         B09A 080
 1052 READ (KIN,3) NETA,(ETA(I),I=1,NETA)                               B09A 081
      READ (KIN,6) KAPPA,CBAR                                           B09A 079
 1051 CONTINUE                                                          B09A
  605 WRITE(KOUT,11)                                                    B09A 091
      WRITE(KOUT,8) CBAR,KAPPA,(ETA(I),I=1,NETA)                        B09A 092
  606 IF(KR(6)-1) 203,203,204                                           B09A 093
  203 READ (KIN,5)  CONE,         RNOSE                                 B09A 094
  204 IF(IABS(KR(6)-2)-1) 207,208,207                                   B09A 095
  207 READ (KIN,5)(ROKAP(IS),IS=1,NS)                                   B09A 096
      IF (NS-1) 234,234,2071                                            B09A 097
 2071 IIS=2                                                             B09A 098
      LNZ=1                                                             B09A 099
      IF(ROKAP(1)) 223,226,226                                          B09A 100
  223 RADNO=-ROKAP(1)                                                   B09A 101
      WRITE (KOUT, 12) RADNO,CONE                                       B09A 102
      ROKAP(1)=0.                                                       B09A 103
      DO 229 IS=1,NS
      IF(ROKAP(IS)) 224,224,225                                         B09A 105
  224 IF(KR(6)) 221,221,222                                             B09A 106
```

```
  222 ROKAP(IS)=S(IS)*SIN(RADNO/57.29578)                              B09A 107
      GO TO 229                                                        B09A 108
  221 ROKAP(IS)=RADNO*SIN(S(IS)/RADNO)                                 B09A 109
  229 CONTINUE                                                         B09A 110
      GO TO 234                                                        B09A 111
  225 IF (IS-NS) 2251,234,234                                          B09A 112
 2251 IIS=IS+1                                                         B09A 113
      LNZ=IS                                                           B09A 114
  226 DO233 IS=IIS,NS                                                  B09A 115
      IF(ROKAP(IS)) 233,233,227                                        B09A 116
  227 IF(IS-1-LNZ) 232,232,228                                         B09A 117
  228 LNZ=LNZ+1                                                        B09A 118
      ROKAP(LNZ)=ROKAP(LNZ-1)+(S(LNZ)-S(LNZ-1))/(S(IS)-S(LNZ-1))*(ROKAP(B09A 119
     1IS)-ROKAP(LNZ-1))                                                B09A 120
      GO TO 227                                                        B09A 121
  232 LNZ=IS                                                           B09A 122
  233 CONTINUE                                                         B09A 123
  234 VKAP=1.                                                          B09A 124
      GO TO 210                                                        B09A 125
  208 DO 209 IS=1,NS                                                   B09A 126
  209 ROKAP(IS)=1.                                                     B09A 127
      VKAP=0.                                                          B09A 128
  210 CONTINUE                                                         B09A
  181 STEF = .481E-12
      IF (KR(9)-3) 197,193,198
  198 IF (KR(9)-4) 193,193,197
  197 DO 191 J=1,NS
      IF (KR9(J)-3) 191,193,192
  192 IF (KR9(J)-4) 191,193,191
  191 CONTINUE
      GO TO 199
  193 READ(KIN,21) (EMIV(I),HCHAR(I), HPYG(I), I=1,3)
      READ(KIN,22) (ASU(I),BSU(I), I=1,3)
   22 FORMAT(6A4)
   21 FORMAT(9E8.3)
   19 FORMAT(/1X39HQUASI-STEADY ENERGY BALANCE AT THE WALL//5X14HSURFACE
     1 NUMBER28X1H114X1H214X1H3/5X17HSURFACE EMITTANCE17X1P3E14.5/5X34HE
     2NTHALPY OF CHAR AT REFERENCE TEMP3E15.5/5X34HENTHALPY OF PYROLYSIS
     3 GAS (BTU/LB)3E15.5/5X27HEQUILIBRIUM SURFACE SPECIES5X3(7X2A4))
      WRITE(KOUT,19) EMIV, HCHAR, HPYG,(ASU(I), BSU(I), I=1,3)
  199 IF (KR(9)-5) 194,196,196
  194 DO 195 J=1,NS
      IF (KR9(J)-5) 195,196,196
  195 CONTINUE
      GO TO 182
  196 READ (KIN,5) EMIST,HTEF,ADUM,BDUM,CDUM
      WRITE (KOUT,20) ADUM,BDUM,CDUM
      WRITE (KOUT,19) EMIST,HTEF
  182 READ(KIN,5)(PTET(IT),IT=1,NITEM)
      READ(KIN,5)(GE(IT),IT=1,NITEM)                                   B09A 131
      READ(KIN,5)(RADFL(IT),IT=1,NITEM)                                B09A 132
 2200 IF(TIME(1)) 2201,220,220
 2201 TIME(1)=-TIME(1)
      WRITE (KOUT,18)(TIME(I),I=1,NITEM)
      TIME(1)=-TIME(1)
      GO TO 2202
  220 WRITE (KOUT,13)(TIME(I),I=1,NITEM)                               B09A 137
 2202 WRITE (KOUT,14)(  GE(I),I=1,NITEM)
      WRITE (KOUT,15)(PTET(I),I=1,NITEM)                               B09A 139
      WRITE (KOUT,17)(RADFL(I),I=1,NITEM)
```

```
000179        RETURN                                   B09A 140
000180        END                                      B09A 141
```

c. Flow Chart

```
C803A
      SUBROUTINE RECASE
      DATA MD(2)/8H        /
      CALL DATE (8,MD)
       CALL TOD ( 10, MD)
      READ(KIN,1)KR,CASE
      READ(KIN,10) IDENT,JSPEC,JTIME
      WRITE(KOUT,4) MD,CASE,KR,IDENT,JSPEC
      KQ(8)=0
```

```
      IF(KR(6)-8) 245,240,245
```

```
  240 KQ(3)=-1
      KR(6)=4
```

```
      GO TO 255
```

```
  245 IF(KR(6)-4) 255,255,250
```

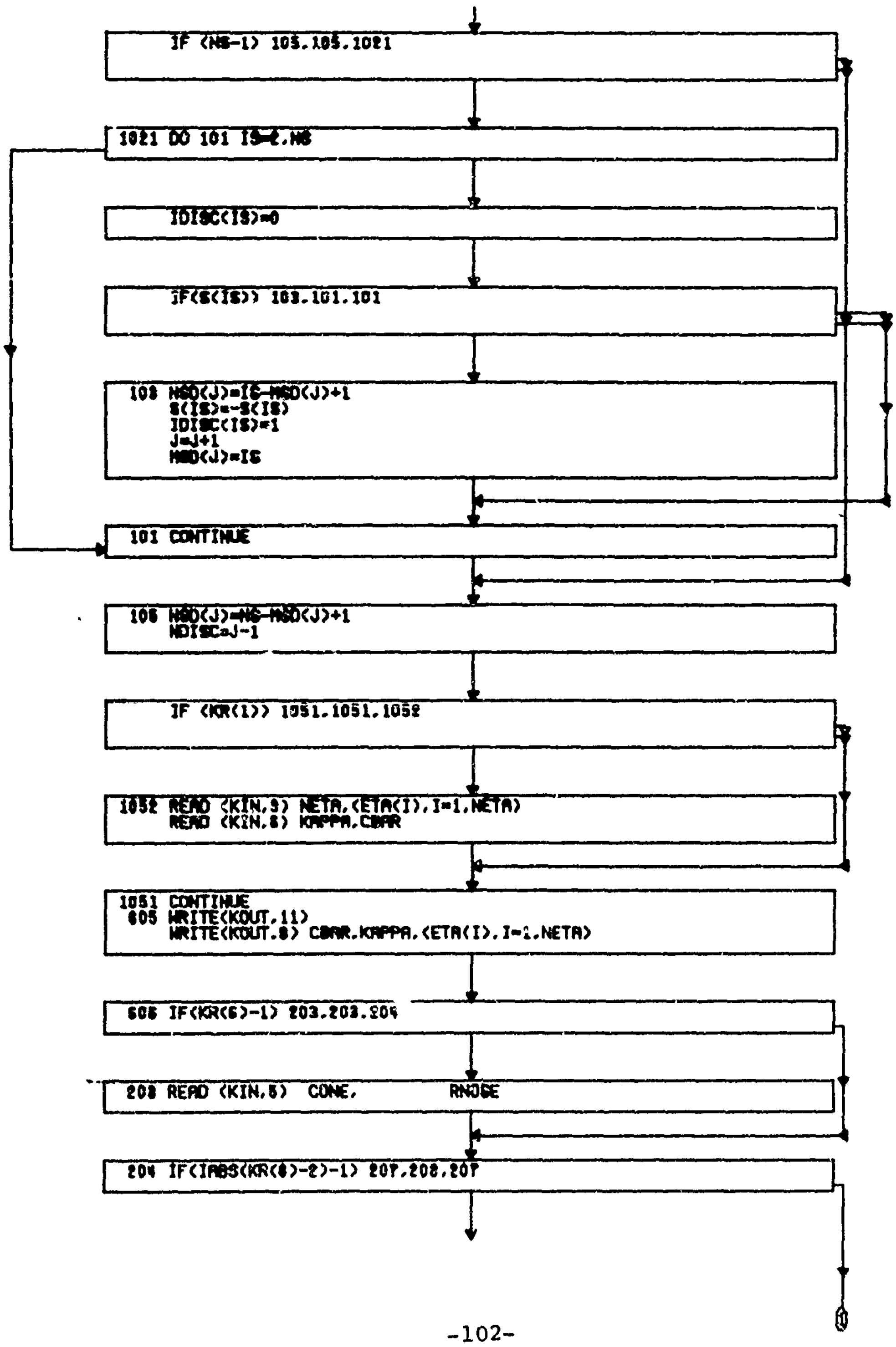
```
  250 KQ(3)=1
      KR(6)=KR(6)-5
```

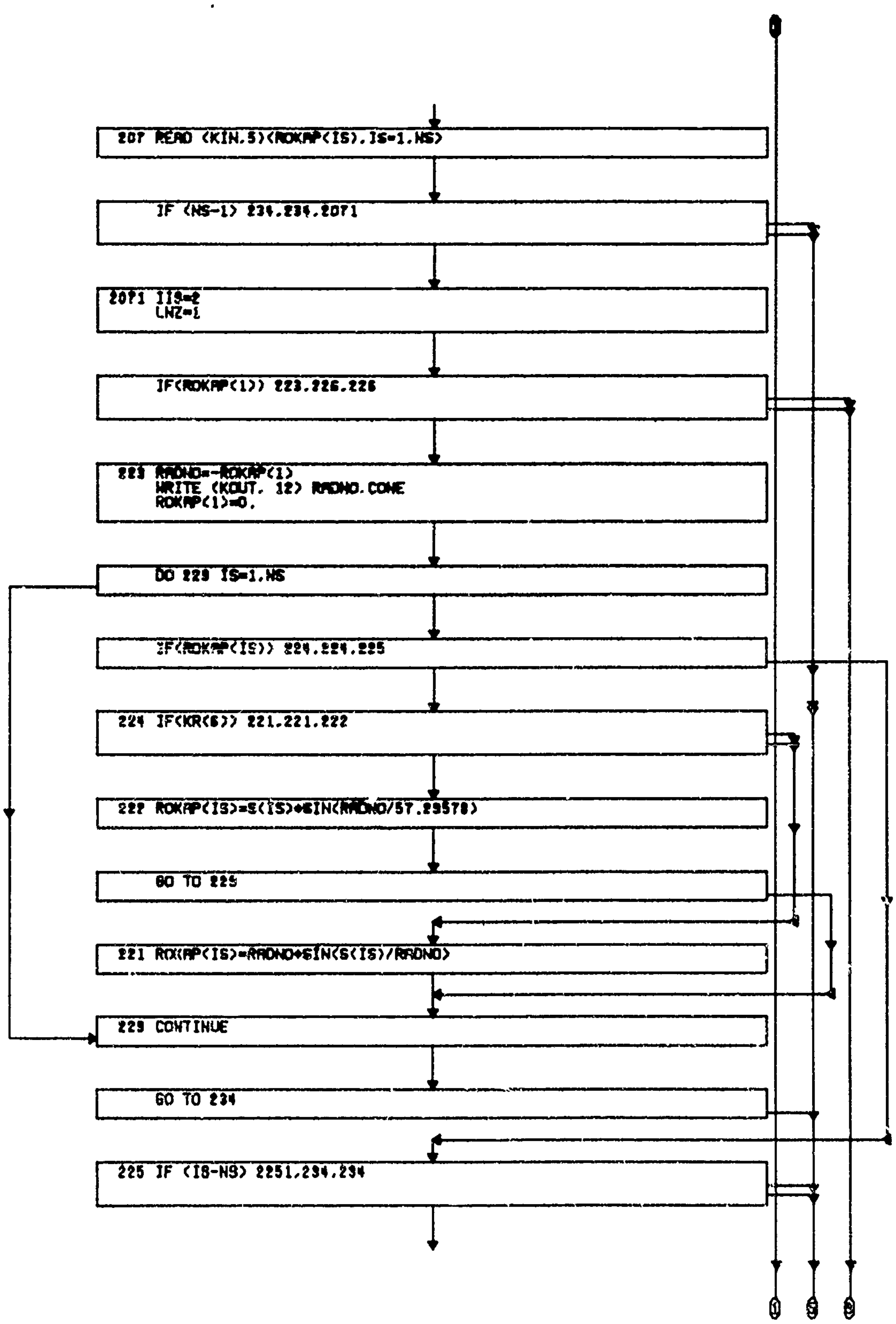
```
  255 READ(KIN,24) NSP,KS
   24 FORMAT(I2,8X70I1)
      NSPM1=NSP-1
      READ (KIN,8) NTIME,(TIME(IT),IT=1,NTIME)
      NITEM=NTIME
      NTIME=1
      READ(KIN,24) NS,KR8
      READ(KIN,5)(S(IS),IS=1,NS)
      KAUXO=1
```

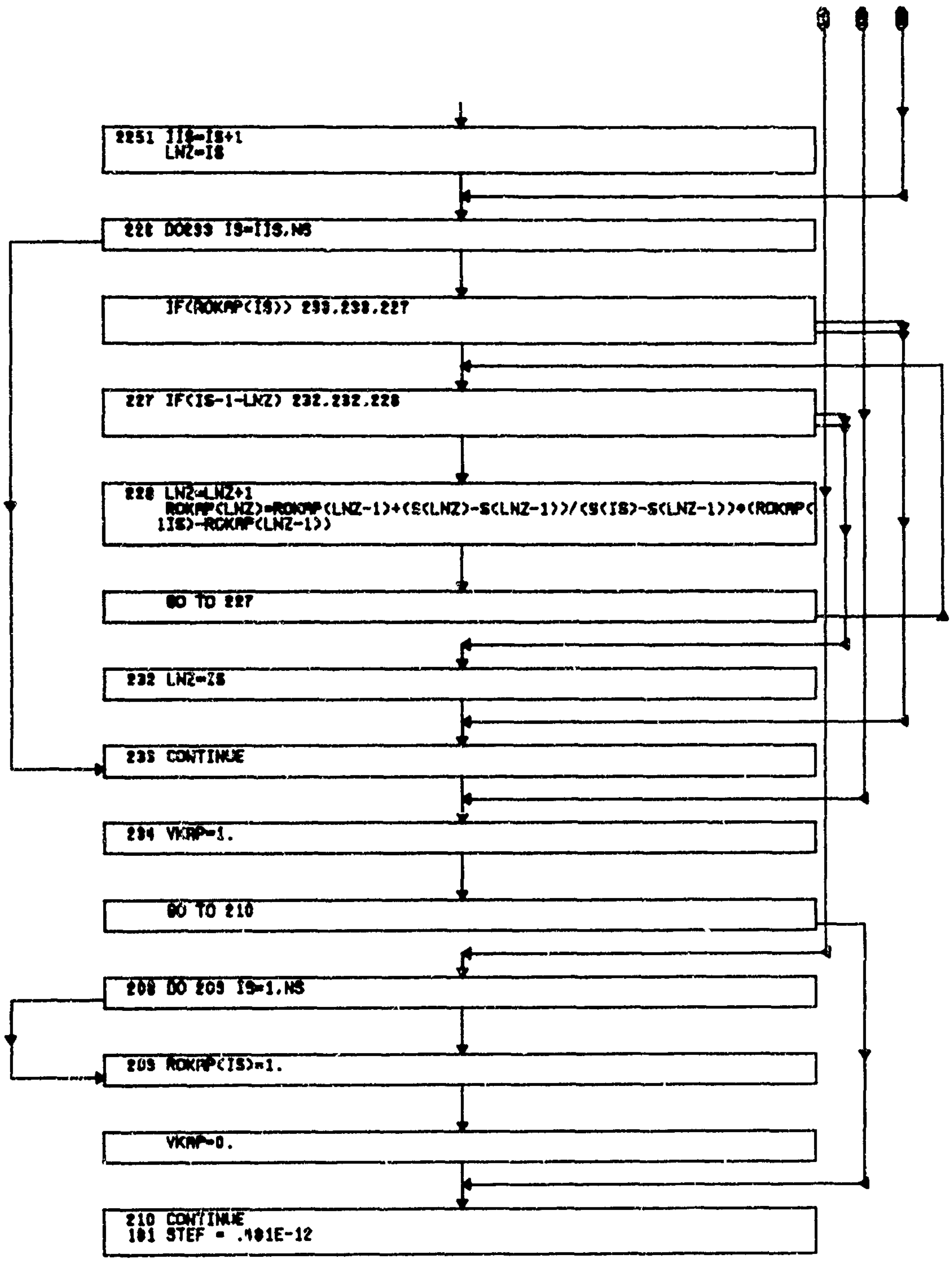
```
      IF(KR (14)-2) 303,303,302
```

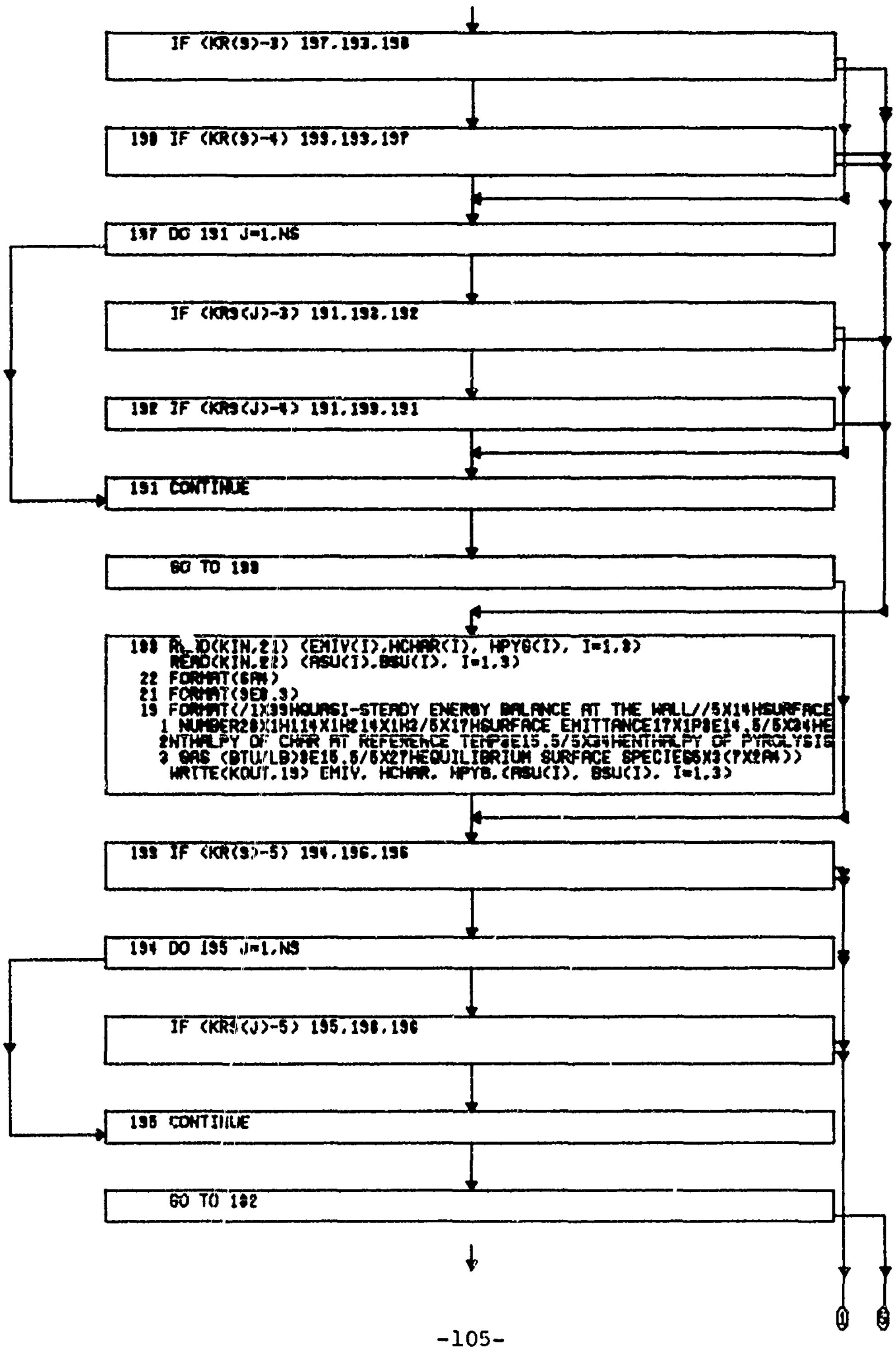
```
  302 KAUXO=KR (14)-1
      KR (14)=KR (14)-3
C     COMPUTE INFORMATION NEEDED TO CONSIDER DISCONTINUITIES
```

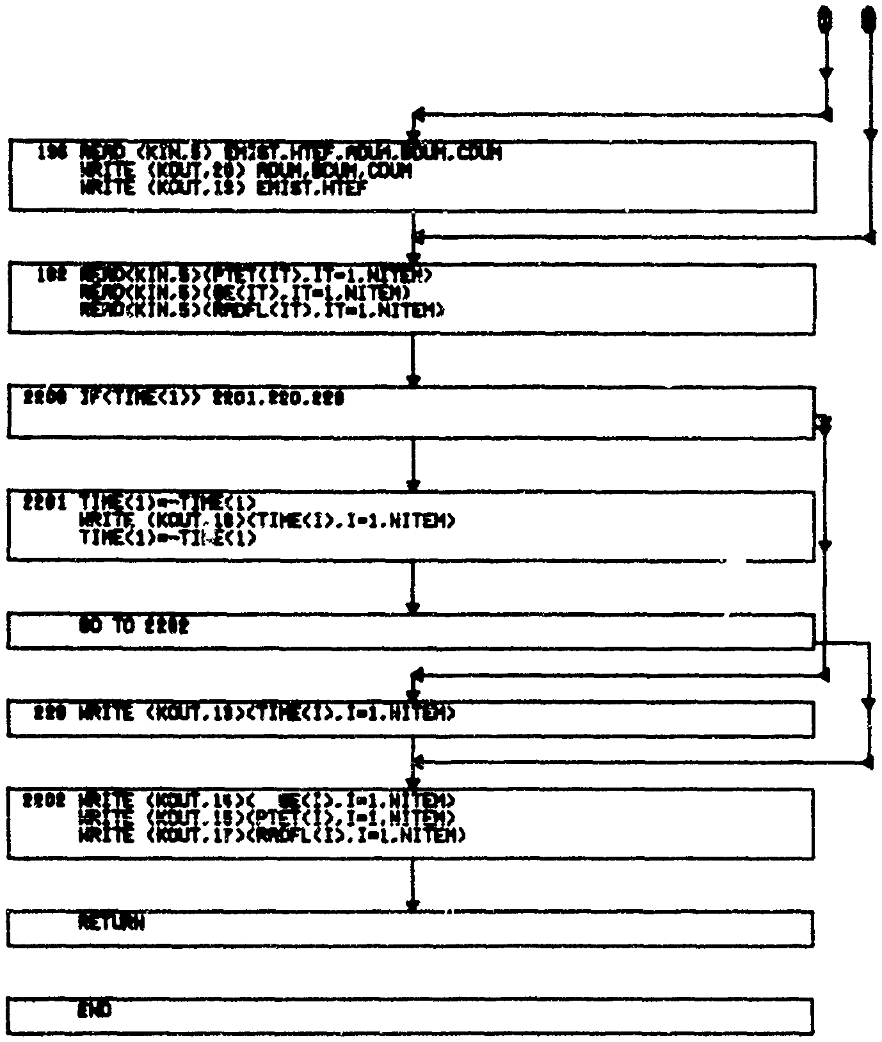
```
  303 J=1
  102 MSD(1)=1
      IDISC(1)=1
      S(1)=ABS(S(1))
```


IF (NS-1) 105.105.1021
1021 DO 101 IS=2.NS
IDISC(IS)=0
IF(S(IS)) 103.101.101
103 NSD(J)=IS-NSD(J)+1
S(IS)=-S(IS)
IDISC(IS)=1
J=J+1
NSD(J)=IS
101 CONTINUE
105 NSD(J)=NS-NSD(J)+1
NDISC=J-1
IF (KR(1)) 1051.1051.1052
1052 READ (KIN.3) NETA.(ETA(I).I=1.NETA)
READ (KIN.6) KAPPA.CBAR
1051 CONTINUE
605 WRITE(KOUT.11)
WRITE(KOUT.8) CBAR.KAPPA.(ETA(I).I=1.NETA)
606 IF(KR(6)-1) 203.203.204
203 READ (KIN.5) CONE, RNOSE
204 IF(IABS(KR(8)-2)-1) 207.208.207
B


207 READ (KIN.5)(ROKAP(IS).IS=1.NS)
IF (NS-1) 234.234.2071
2071 IIS=2
LNZ=1
IF(ROKAP(1)) 223.226.226
223 RADNO=-ROKAP(1)
WRITE (KOUT. 12) RADNO.CONE
ROKAP(1)=0.
DO 229 IS=1.NS
IF(ROKAP(IS)) 224.224.225
224 IF(KR(6)) 221.221.222
222 ROKAP(IS)=S(IS)*SIN(RADNO/57.29578)
GO TO 225
221 ROKAP(IS)=RADNO*SIN(S(IS)/RADNO)
229 CONTINUE
GO TO 234
225 IF (IS-NS) 2251,234,234


2251 IIS=IS+1
LNZ=IS
226 DO233 IS=IIS,NS
IF(ROKAP(IS)) 233,233,227
227 IF(IS-1-LNZ) 232,232,228
228 LNZ=LNZ+1
ROKAP(LNZ)=ROKAP(LNZ-1)+(S(LNZ)-S(LNZ-1))/(S(IS)-S(LNZ-1))*(ROKAP(
1IS)-ROKAP(LNZ-1))
GO TO 227
232 LNZ=IS
233 CONTINUE
234 VKAP=1.
GO TO 210
208 DO 209 IS=1,NS
209 ROKAP(IS)=1.
VKAP=0.
210 CONTINUE
101 STEF = .401E-12


IF (KR(9)-3) 197,198,198
198 IF (KR(9)-4) 199,199,197
197 DO 191 J=1,NS
IF (KR9(J)-3) 191,192,192
192 IF (KR9(J)-4) 191,199,191
191 CONTINUE
GO TO 199
199 READ(KIN,21) (EMIV(I),HCHAR(I), HPYG(I), I=1,3)
READ(KIN,22) (ASU(I),BSU(I), I=1,3)
22 FORMAT(6A4)
21 FORMAT(9E8.3)
19 FORMAT(/1X39HQUASI-STEADY ENERGY BALANCE AT THE WALL//5X14HSURFACE
1 NUMBER20X1H114X1H214X1H3/5X17HSURFACE EMITTANCE17X1P8E14.5/5X34HE
2NTHALPY OF CHAR AT REFERENCE TEMP8E15.5/5X34HENTHALPY OF PYROLYSIS
3 GAS (BTU/LB)8E15.5/5X27HEQUILIBRIUM SURFACE SPECIES5X3(7X2A4))
WRITE(KOUT,19) EMIV, HCHAR, HPYG,(ASU(I), BSU(I), I=1,3)
193 IF (KR(9)-5) 194,196,196
194 DO 195 J=1,NS
IF (KR9(J)-5) 195,198,196
195 CONTINUE
GO TO 192


196 READ (KIN.5) EMIST.HTEF.ADUM.BDUM.CDUM
WRITE (KOUT,20) ADUM,BDUM,CDUM
WRITE (KOUT,19) EMIST.HTEF
102 READ(KIN.5)(PTET(IT).IT=1.NITEM)
READ(KIN.5)(BE(IT).IT=1.NITEM)
READ(KIN.5)(RADFL(IT).IT=1.NITEM)
2200 IF(TIME(1)) 2201.220.220
2201 TIME(1)=-TIME(1)
WRITE (KOUT.18)(TIME(I).I=1.NITEM)
TIME(1)=-TIME(1)
GO TO 2202
220 WRITE (KOUT.18)(TIME(I).I=1.NITEM)
2202 WRITE (KOUT.16)(BE(I).I=1.NITEM)
WRITE (KOUT.15)(PTET(I).I=1.NITEM)
WRITE (KOUT.17)(RADFL(I).I=1.NITEM)
RETURN
END

10. SUBROUTINE HISTXI - B10A

a. Function

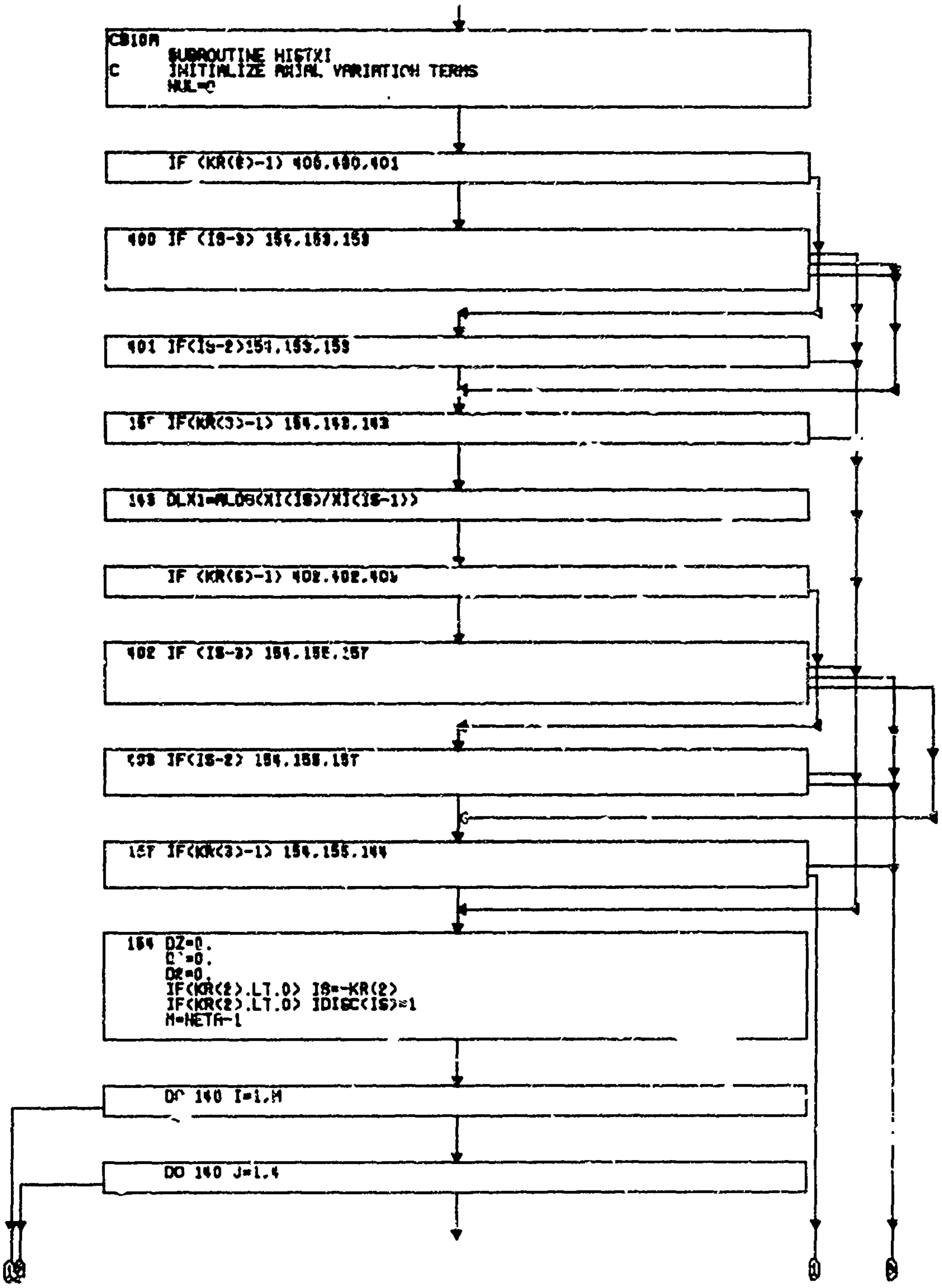
Computes terms involving derivatives with respect to XI (i.e., non-similar terms) and stores those upstream quantities needed for these difference relations. Called by SETUP. Calls TAYLOR.

b. Listing

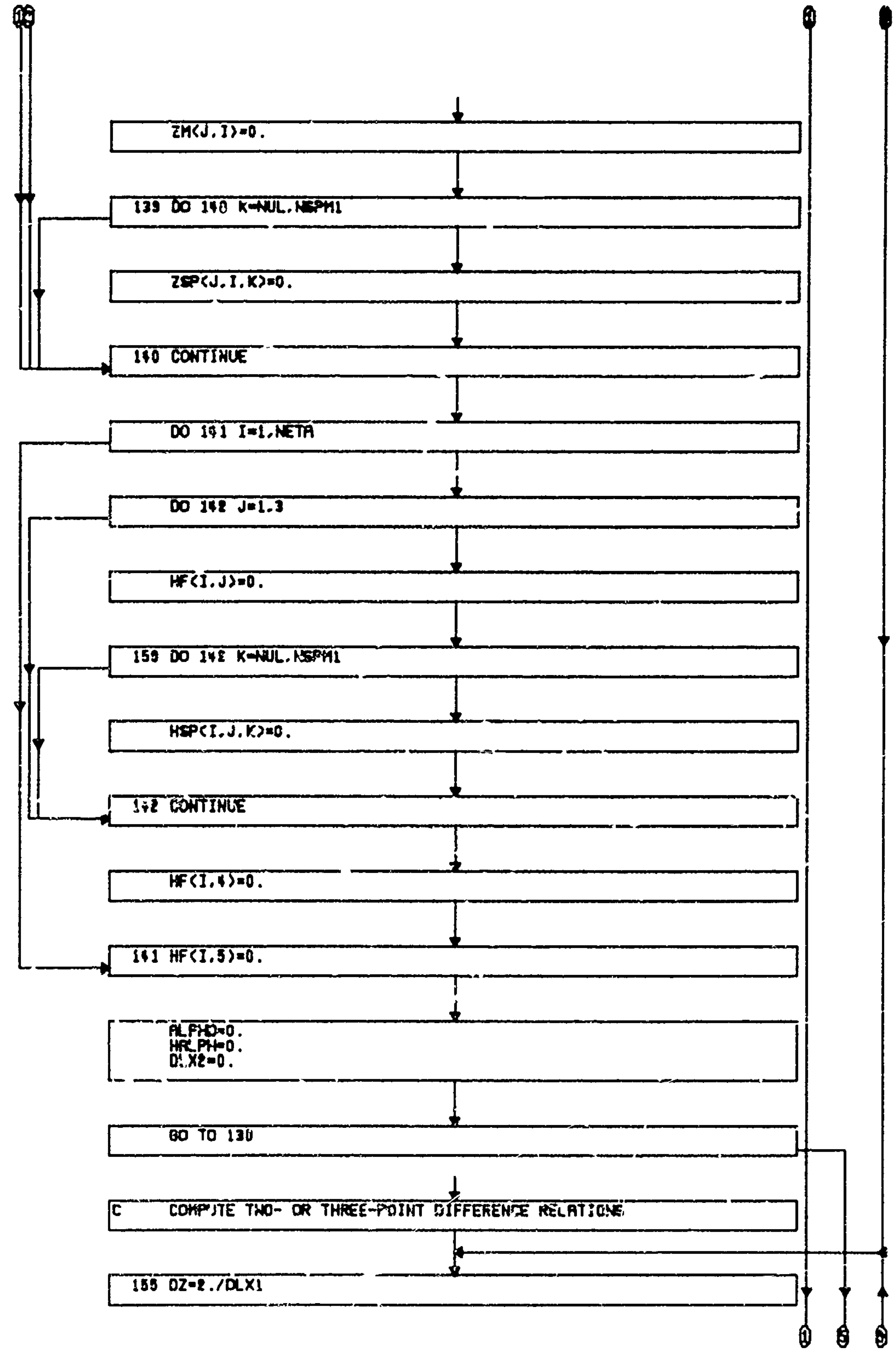
```
CB10A                                                                   B10A 001
      SUBROUTINE HISTXI                                                 B10A 002
      COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)      B10A   3*NEW
     1,LAR(153),BA1(43,18),BA2(30,15)                                   B10A   4*NEW
      COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, *B10A   5*NEW
     1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFH,DLX2  B10A   6*NEW
     2,CSM(40),BETAM(40)                                                B10A   7*NEW
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB10A   8*NEW
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B10A   9*NEW
     2,R(8),       NWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B10A  10*NEW
     3,KAUXO,JTIME,JSPEC,MD(3)                                          B10A  11*NEW
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B10A  12*NEW
     1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B10A  13*NEW
     2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                            B10A  14*NEW
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B10A  15*NEW
      DIMENSION FD(4),GD(4),SPD(4)                                      B10A 018*-18
C     INITIALIZE AXIAL VARIATION TERMS                                  B10A 019
      NUL=0                                                             B10A 020
      IF (KR(6)-1) 400,400,401                                          B10A 021
  400 IF (IS-3) 154,153,153                                             B10A 022
  401 IF(IS-2)154,153,153                                               B10A 023
  153 IF(KR(3)-1) 154,143,143                                           B10A 024
  143 DLX1=ALOG(XI(IS)/XI(IS-1))                                        B10A 025
      IF (KR(6)-1) 402,402,403                                          B10A 026
  402 IF (IS-3) 154,155,157                                             B10A 027
  403 IF(IS-2) 154,155,157                                              B10A 028
  157 IF(KR(3)-1) 154,155,144                                           B10A 029
  154 D7=0.                                                             B10A 030
      D1=0.                                                             B10A 031
      D2=0.                                                             B10A 032
      IF(KR(2).LT.0) IS=-KR(2)
      IF(KR(2).LT.0) IDISC(IS)=1
      M=NETA-1                                                          B10A 033
      DO 140 I=1,M                                                      B10A 034
      DO 140 J=1,4                                                      B10A 035
      ZM(J,I)=0.                                                        B10A 036
  139 DO 140 K=NUL,NSPM1                                                B10A 037
      ZSP(J,I,K)=0.                                                     B10A 038
  140 CONTINUE                                                          B10A 039
      DO 141 I=1,NETA                                                   B10A 040
      DO 142 J=1,3                                                      B10A 041
      HF(I,J)=0.                                                        B10A 042
  159 DO 142 K=NUL,NSPM1                                                B10A 043
      HSP(I,J,K)=0.                                                     B10A 044
  142 CONTINUE                                                          B10A 045
      HF(I,4)=0.                                                        B10A 046
  141 HF(I,5)=0.                                                        B10A 047
      ALPHD=0.                                                          B10A 048
      HALPH=0.                                                          B10A 049
      DLX2=0.                                                           B10A 050
      GO TO 130                                                         B10A 051
C     COMPUTE TWO- OR THREE-POINT DIFFERENCE RELATIONS                  B10A 052
  155 D7=2./DLX1                                                        B10A 053
      D1=-D7                                                            B10A 054
      D2=0.                                                             B10A 055
      GO TO 145                                                         B10A 056
  144 J=IDISC(IS-1)                                                     B10A 057
      IF(J)121,121,155                                                  B10A 058
```

```
  171 DZ=DLX1+DLX2
      D1=-DZ/(DLX1*DLX2)*2.
      D2=DLX1/(DZ*DLX2)*2.
      DZ=-D1-D2
  145 DLX2=DLX1
      ALPHD=D1*ALPH+D2*HALPH
      HALPH=ALPH
  172 FD(3)=D1*F(4,1)+D2*HF(1,4)
      GD(3)=D1*G(3,1)+D2*HG(1,3)
      DO 147 I=2,NETA
      FD(1)=D1*F(2,I)+D2*HF(I,2)
      FD(2)=D1*F(3,I)+D2*HF(I,3)
      FD(4)=FD(3)
      FD(3)=D1*F(4,I)+D2*HF(I,4)
      CALL TAYLOR(DETA(I-1),FD(2),FD(1),ZM(1,I-1))
      GD(1)=D1*G(1,I)+D2*HG(I,1)
      GD(2)=D1*G(2,I)+D2*HG(I,2)
      GD(4)=GD(3)
      GD(3)=D1*G(3,I)+D2*HG(I,3)
  147 CALL TAYLOR(DETA(I-1),GD(2),GD(1),ZG(1,I-1))
      IF(NSPM1) 162,162,166
  166 DO 151 K=1,NSPM1
      SPD(3)=D1*SP(3,1,K)+D2*HSP(1,3,K)
      DO 151 I=2,NETA
      SPD(1)=D1*SP(1,I,K)+D2*HSP(I,1,K)
      SPD(2)=D1*SP(2,I,K)+D2*HSP(I,2,K)
      SPD(4)=SPD(3)
      SPD(3)=D1*SP(3,I,K)+D2*HSP(I,3,K)
  151 CALL TAYLOR (DETA(I-1),SPD(2),SPD(1),ZSP(1,I-1,K))
C-----SAVE HISTORIC VALUES
  162 DO 164 I=1,NETA
      HF(I,4)=F(4,I)
      HF(I,5)=D1*F(1,I)+D2*HF(I,1)
      DO 164 J=1,3
      HF(I,J)=F(J,I)
      HG(I,J)=G(J,I)
      IF(NSPM1) 164,164,165
  165 DO 149 K=1,NSPM1
  149 HSP(I,J,K)=SP(J,I,K)
  164 CONTINUE
C     COMPUTE GROUPINGS WHICH DEPEND ON DZ
  130 C1=1.+DZ
      C2=-C1-DZ
      C3=C3M(IS)
      BETA=BETAM(IS)
      C4=BETA+C1
 9904 FORMAT(6XI2/8X1P10E10.3/8X8E10.3/:8X10E10.3))
      IF(KR(17)) 9905,9906,9905
 9905 CONTINUE
      WRITE(KOUT,9907)
 9907 FORMAT(2X27HDEBUG IS,DLX1...,ZM,ZG,HF,HG)
      WRITE(KOUT,9904) IS,DLX1,DLX2,DZ,D1,D2,ALPHD,HALPH,C1,C2,C4,    FD
     1,GD,((ZM(I,J),J=1,6),I=1,4),((ZG(I,J),J=1,6),I=1,4),((HF(I,J),
     2 J=1,5),I=1,7),((HG(I,J),J=1,3),I=1,7)
      IF(NSPM1) 9906,9906,9908
 9908 WRITE(KOUT,9909)(((ZSP(I,J,K),K=1,NSPM1),J=1,6),I=1,4),(((HSP(I,J,
     1 K),K=1,NSPM1),J=1,3),I=1,7)
 9909 FORMAT(2X13HDEBUG ZSP,HSP/(2X10F10.3))
 9906 CONTINUE
      RETURN
      END
```

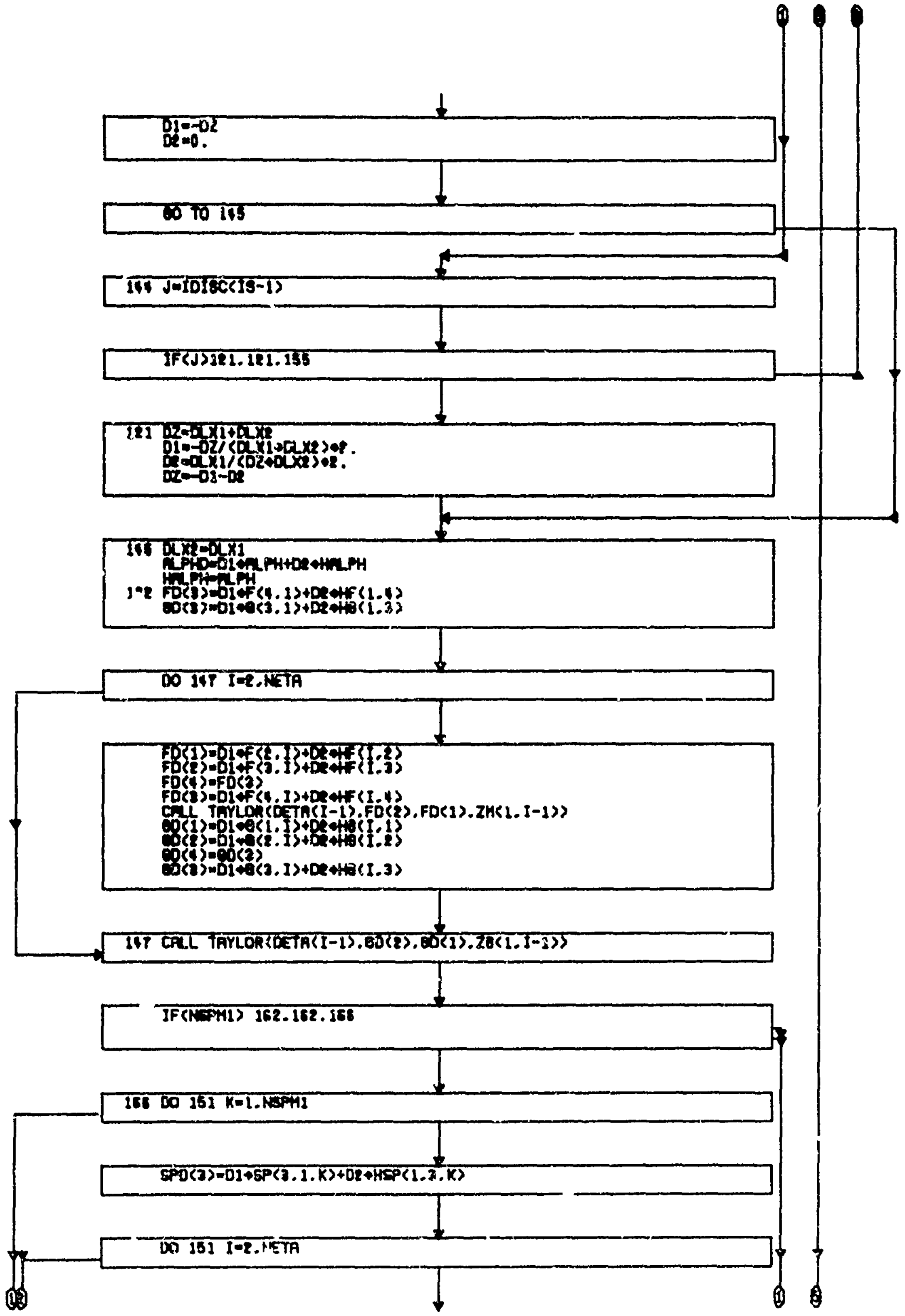
c. Flow Chart

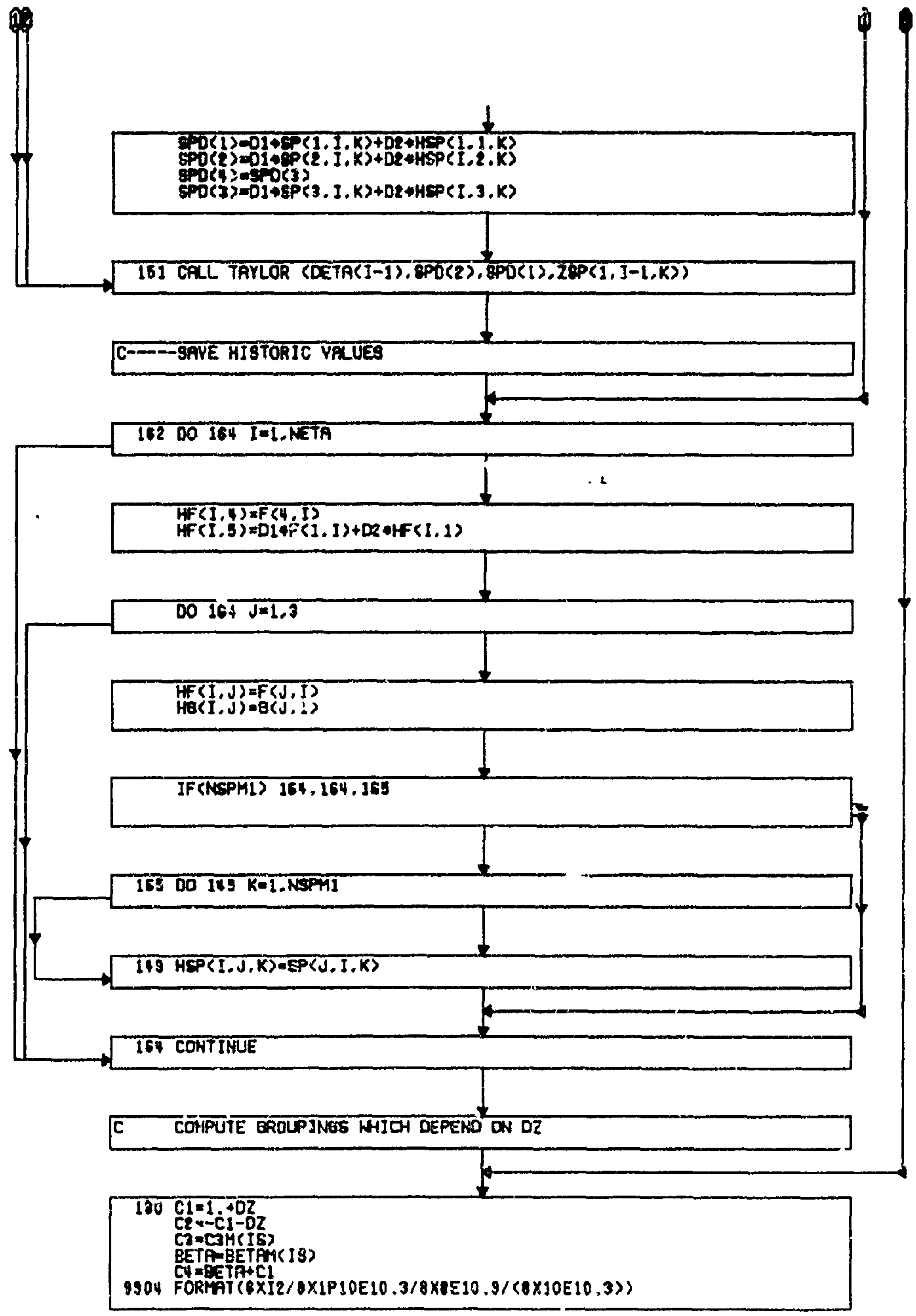


C310A
SUBROUTINE HISTXI
C INITIALIZE AXIAL VARIATION TERMS
NUL=0
IF (KR(8)-1) 400,400,401
400 IF (IS-3) 154,153,153
401 IF(IS-2)154,153,153
153 IF(KR(3)-1) 154,143,143
143 DLX1=ALOG(XI(IS)/XI(IS-1))
IF (KR(6)-1) 402,402,403
402 IF (IS-3) 154,155,157
403 IF(IS-2) 154,155,157
157 IF(KR(3)-1) 154,155,144
154 DZ=0.
D`=0.
DX=0.
IF(KR(2).LT.0) IS=-KR(2)
IF(KR(2).LT.0) IDISC(IS)=1
M=NETA-1
DO 140 I=1,M
DO 140 J=1,4



ZM(J,I)=0.
139 DO 140 K=NUL,NSPM1
ZSP(J,I,K)=0.
140 CONTINUE
DO 141 I=1,NETA
DO 142 J=1,3
HF(I,J)=0.
159 DO 142 K=NUL,NSPM1
HSP(I,J,K)=0.
142 CONTINUE
HF(I,4)=0.
141 HF(I,5)=0.
ALPHO=0.
HALPH=0.
DLX2=0.
GO TO 130
C COMPUTE TWO- OR THREE-POINT DIFFERENCE RELATIONS
155 DZ=2./DLX1


D1=-D2
D2=0.
GO TO 145
144 J=IDISC(IS-1)
IF(J)121.121.155
121 DZ=DLX1+DLX2
D1=-DZ/(DLX1+DLX2)*2.
D2=DLX1/(DZ*DLX2)*2.
DZ=-D1-D2
145 DLX2=DLX1
ALPHD=D1*ALPH+D2*HALPH
HALPH=ALPH
1*2 FD(3)=D1*F(4.1)+D2*HF(1.4)
GD(3)=D1*G(3.1)+D2*HG(1.3)
DO 147 I=2.NETA
FD(1)=D1*F(2.I)+D2*HF(I.2)
FD(2)=D1*F(3.I)+D2*HF(I.3)
FD(4)=FD(2)
FD(3)=D1*F(4.I)+D2*HF(I.4)
CALL TAYLOR(DETA(I-1).FD(2).FD(1).ZM(1.I-1))
GD(1)=D1*G(1.I)+D2*HG(I.1)
GD(2)=D1*G(2.I)+D2*HG(I.2)
GD(4)=GD(2)
GD(3)=D1*G(3.I)+D2*HG(I.3)
147 CALL TAYLOR(DETA(I-1).GD(2).GD(1).ZG(1.I-1))
IF(NSPM1) 162.162.166
166 DO 151 K=1.NSPM1
SPD(3)=D1*SP(3.1.K)+D2*HSP(1.3.K)
DO 151 I=2.NETA


SPD(1)=D1*SP(1,I,K)+D2*HSP(I,1,K)
SPD(2)=D1*SP(2,I,K)+D2*HSP(I,2,K)
SPD(4)=SPD(3)
SPD(3)=D1*SP(3,I,K)+D2*HSP(I,3,K)
151 CALL TAYLOR (DETA(I-1),SPD(2),SPD(1),ZSP(1,I-1,K))
C-----SAVE HISTORIC VALUES
152 DO 164 I=1,NETA
HF(I,4)=F(4,I)
HF(I,5)=D1*F(1,I)+D2*HF(I,1)
DO 164 J=1,3
HF(I,J)=F(J,I)
HS(I,J)=S(J,I)
IF(NSPM1) 164,164,165
165 DO 149 K=1,NSPM1
149 HSP(I,J,K)=SP(J,I,K)
164 CONTINUE
C COMPUTE GROUPINGS WHICH DEPEND ON DZ
130 C1=1.+DZ
C2=-C1-DZ
C3=C3M(IS)
BETA=BETAM(IS)
C4=BETA*C1
9904 FORMAT(8XI2/8X1P10E10.3/8X8E10.3/(8X10E10.3))

```
      IF(KR(17)) 9305.9306.9305

9305  CONTINUE
      WRITE(KOUT.9307)
9307  FORMAT(2X27HDEBUG IS.DLX1...ZM.ZG.HF.HG)
      WRITE(KOUT.9304) IS,DLX1,DLX2,DZ,D1,D2,ALPHD,HALPH,C1,C2,C4,     FD
     1.BO.((ZM(I.J).J=1.6).I=1.4).((ZG(I.J).J=1.6).I=1.4).((HF(I.J).
     2 J=1.5).I=1.7).((HG(I.J).J=1.3).I=1.7)

      IF(NSPM1) 9306.9306.9308

9308  WRITE(KOUT.9309)(((ZSP(I.J.K).K=1.NSPM1).J=1.6).I=1.4).(((HSP(I.J.
     1 K).K=1.NSPM1).J=1.3).I=1.7)
9309  FORMAT(2X13HDEBUG ZSP.HSP/(2X10E10.3))

9306  CONTINUE

      RETURN

      END
```

11. SUBROUTINE OUTPUT - B11A

a. Function

Prints standard boundary layer output block for converged solution or, if requested, at the end of each iteration. Called by BLIMP.

b. Listing

```
      CH11A                                                             B11A 001
      SUBROUTINE OUTPUT                                                 B11A 002
      DIMENSION CIJ( 71,1)                                              B11A  03*NEW
      COMMON/BLPCOM/  NOA( 71),  MOR( 71),NSPEC,FR( 71,15),W(3),LEF(10) B11A   4*NEW
     1,LEFS(10),PIEASE,LEFW(10)                                         B11A   5*NEW
      COMMON/COECOM/            C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B11A   6*NEW
     1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB11A   7*NEW
     232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4B11A   8*NEW
     3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB11A   9*NEW
     465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81B11A  10*NEW
     5,C82,C83,C84,C85,C86,C87,C88                                      B11A  11*NEW
      COMMON/COECON/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)   B11A  12*NEW
     1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)     B11A  13*NEW
     2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)  B11A  14*NEW
     3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9) B11A  15*NEW
     4,CKK3( 8, 8)                                                      B11A  16*NEW
      COMMON/CHRCOM/HCARB,EMIS,STFF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMISTB11A  17*NEW
     1,HPG,ASU(3),BSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(40),ISU            B11A  18*NEW
      COMMON/EDGCOM/            PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B11A  19*NEW
     1UF(40),RHOE(40),VMUF(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90   B11A  20*NEW
     2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                    B11A  21*NEW
      COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,    B11A  22*NEW
     1EPSA(15),EPS1,EL(15),CPI(15,2),DLI(153),DEPS(153),DEPC,TREF,RETR  B11A  23*NEW
      COMMON/EQPCOM/  RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B11A  24*NEW
     1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B11A  25*NEW
     2 KAT(10),IR(10),I7,K2(10),LAMI( 71),P,Z,TK(10, 7),VN( 71),        B11A  26*NEW
     3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),YYY( 71),YW( 71),GG( 71)B11A  27*NEW
     4 ,TQ(10, 7),EPOVRK,SIGMA,BASMOL                                   B11A  28*NEW
      COMMON/EGTCOM/SIP,HIP,EEL,EENL,FLIQ,CPF,IRE,IER,AA,IITS,IN,IL,IIT,B11A  29*NEW
     1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,BX,ISP2,ISPQ,   B11A  30*NEW
     2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HHG, B11A  31*NEW
     3 CCPG,TTMIN,TTMAX,L2,L3,IB(11),FH(10),EBL(10),A(16,16),BB(16),    B11A  32*NEW
     4 TH( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B11A  33*NEW
     5 CP( 71),HH( 71),SH( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),       B11A  34*NEW
     6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JZ( 4)                     B11A  35*NEW
      COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)      B11A  36*NEW
     1,LAR(153),BA1(43,18),BA2(30,15)                                   B11A  37*NEW
      COMMON/FLXCOM/DELQW,DELJW( 8),DQNL(153),DJNL(153, 8),WALLQ        B11A  38*NEW
     1,WALLJ( 8),QW,VJKW( 9),TPWALL                                     B11A  39*NEW
      COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BET: ZM(4,14),ZG(4,14),ZSP(4,14, 8B11A  40*NEW
     1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B11A  41*NEW
     2,C3M(40),RETAM(40)                                                B11A  42*NEW
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB11A  43*NEW
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B11A  44*NEW
     2,R(8),      MNE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B11A  45*NEW
     3,KAUXO,JTIME,JSPEC,MD(3)                                          B11A  46*NEW
      COMMON/OUTCOM/Y(15),RES,DELST,THENGY,THMOM,CH,BLOW,SHEAR,CF,SHAPE B11A  47*NEW
     1 ,CM( 9),THELEM( 9)                                               B11A  48*NEW
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B11A  49*NEW
     1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B11A  50*NEW
     2CONF,RADEL( 50),RADR(40),RADS(40),IRAD                            B11A  51*NEW
      COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)   B11A  52*NEW
     1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK   ),DZKH( 8),  DB11A  53*NEW
     2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DS    8),DCAPCK( 8)B11A  54*NEW
     3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),CMU12K( ^   KK( 8, 8)    B11A  55*NEW
     4,DPHIKK( 8, 8),        DMU4H,DMU3H,DHTILH,VMU12,C   R, PTIL,HTIL  B11A  56*NEW
     5, MU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B11A  57*NEW
     6, 5),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B11A  58*NEW
```

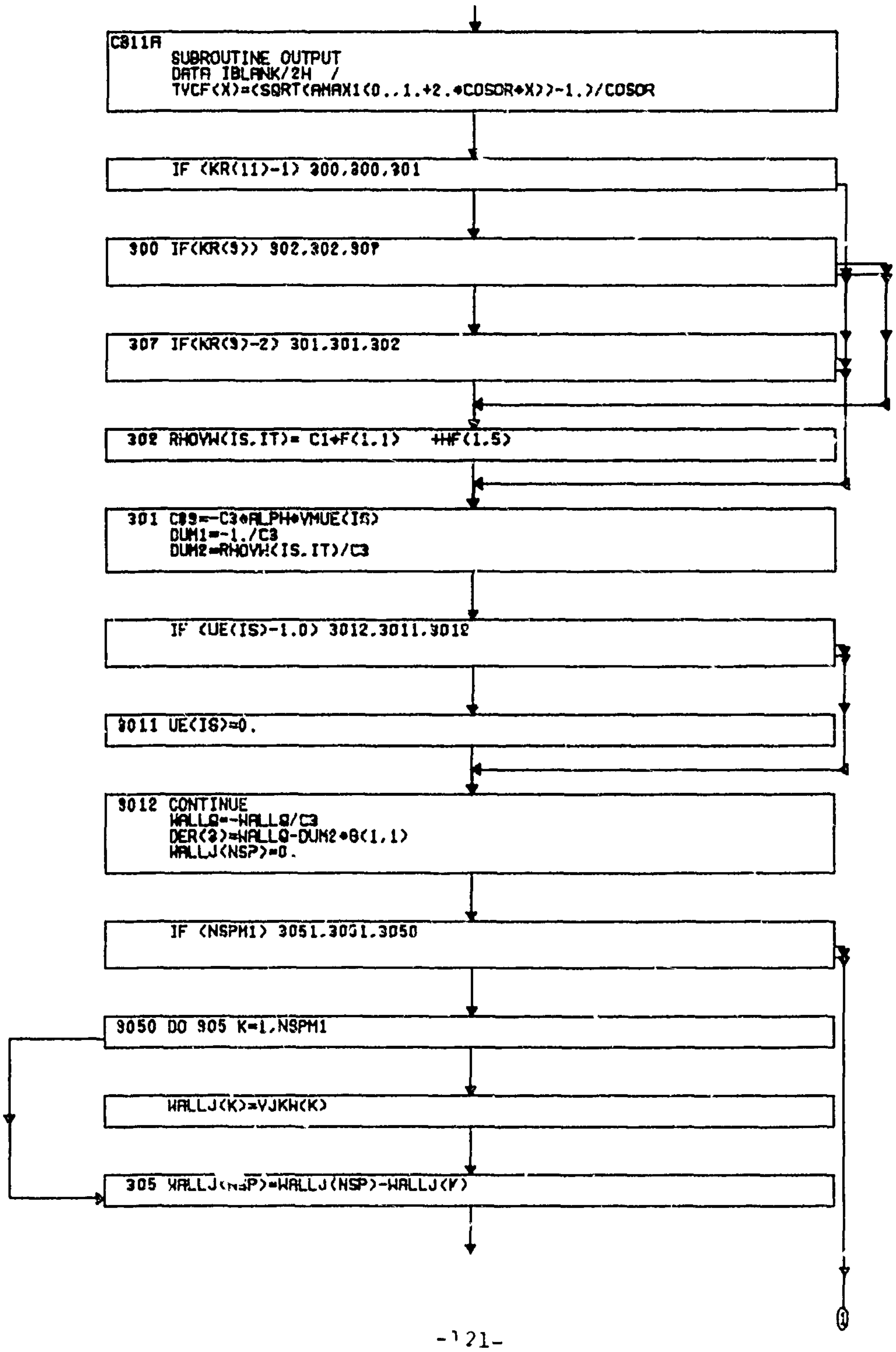
```
      COMMON/TEPCOM/SPDUM( 8),DER(40),DUMM1(15),SLOPE(15),REDUM(15)     B11A  5 NEW
     1,SDUM1(40),SDUM2(40),FWDUM(40),XICON(40),FWCON(40),FWINIT( 1)     B11A  0NEW
     2,XIINIT( 1),DELS( 40)                                             B11A  61NEW
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B11A  62NEW
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8                B11A  63NEW
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHO               B11A  64NEW
      EQUIVALENCE            (VNU,CIJ)                                  B11A 037-62
    1 FORMAT(/6X109H ALPHA         XI         ROKAP     PRESSURE    DOE  B11A 057
     1BETA     FLUX NOR-            HEAT FLUXES                /3X110H
     2           (LB           (FT)       (ATM)      VELOCITY     MALIZINB11A 059
     3G DIFFUSIONAL TOT ENTH  RERAD          QCOND /3X11 H          /SEC)
     4**2                        (FT/SEC)              PARAMETER
     5(BTU/SEC SQ FT)                 /5X1P11E10.3)
    2 FORMAT / X109H  WALL                         MASS FLUXES          ELB11A 069
     1EMENTAL    SS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR          /5X 50H  B11A 070
     2SHEAR      ECH REM  PYROL GAS    CHAR     TOTAL GAS 8(1X2A4,1X))
   19 FORMAT                                          (5X 50H(LB/SQ FT) B11A 073
     3              (LB/SEC SQ FT)                          )           B11A 074
    3 FORMAT(5X1P12E10.3)
   16 FORMAT(/6X109HMOM TRANS HEAT TRANS      BLOWING PARAMETERS        ELB11A 076
     1ELEMENTAL MASS TRANSFER COEFFICIENTS,                      /5X110H  B11A 077
     2COEFF,     COEFF,            (BASED ON CH) FOR           RHOE*UE*CM (LB11A 078
     2B/SEC SQ FT) FOR                                  /4X51HRHO*UE*CF/2 B11A 079
     3RHO*UE*CH PYROL GAS    CHAR      TOTAL GAS                        B11A 080
     4 8(1X2A4,1X))
    4 FORMAT(5X110H MOMENTUM  DISPLACE  EFFECTIVE ENTHALPY  REYNOLDS  MA
     1SS THICKNESSES (FT) FOR                                   /5X110HTHB11A 083
     2ICKNESS,THICKNESS,   BODY   THICKNESS   NUMBER
     3                                       /5X 50H  THETA    DELSTAB11A 085
     4R    DISPLACE.  LAMBDA   PER FOOT 8(1X2A4,1X))
   20 FORMAT(2X,4(6X,4H(FT))/5X1P12E10.3)
    5 FORMAT(/2X17HNODAL INFORMATION)                                   B11A 091
    6 FORMAT(5X9HDISTANCE,4X3HETA,8X1HF,9X2HFP,7X3HFPP,7X5HSHEAR,2X11HTO
     1TAL ENTH-,3X2HGP,7X3HGPP,6X6HSTATIC,5X4HTEMP,5X8HELECTRON/
     25X9HFROM WALL,23X7H(=U/UE),23X7HHALPY,G,23X8HENTHALPY,12X9HCOLL FR
     3EQ/8X4H(FT),44X9H(LB/FTSQ),2X8H(BTU/LB),2X8H(BTU/LB),2X8H(BTU/LB),
     42X8H(BTU/LB),2X7H(DEG R),4X7H(1/SEC))
    7 FORMAT(5X110H DISTANCE  DENSITY, VISCOSITY,  RHO*MU   SPECIFIC  THB11A 098
     1ERMAL    PRANDTL   MODIFIED MOLECULAR  RHOSQ*EPS    MACH  /5X110HFR
     2OM WALL     RHO          MU     /RHOE*MUE,   HEAT    COND (BTU  NUMBERB11A 100
     3   SCHMIDT    WEIGHT    /RHOE*MUE   NUMBER /5X110H    (FT)    (LB/CU
     4FT) LB/SEC FT    C       (BTU/LB R) /SEC FT R)             NUMBER   B11A 102
     5                             )                                    B11A 103
    8 FORMAT (/2X78HELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVB11A 104
     1ATIVES WITH RESPECT TO ETA,/)                                     B11A 105
   12 FORMAT(/)                                                         B11A 126
   13 FORMAT(/    43X21HDISTANCE FROM WALL,FT/(15X,1P10E10.3/20X,
     1 1P9E10.3))
   14 FORMAT(6X,2A4,1X,1P10E10.3/20X,1P9E10.3/(15X,1P10E10.3/20X,1P
     1 9E10.3))
   15 FORMAT (15X,1P10E10.3/20X1P9E10.3)
   16 FORMAT (/2X14HMOL  FRACTIONS,/)                                   B11A 130
   17 FORMAT(/23H    SURFACE SPECIES IS 2A4)
  310 FORMAT(A2,3I2,1P6E12.5)                                           B11A 131
  312 FORMAT(A2,3I2,1P6E12.5/(8X,1P6E12.5))                             B11A 132
  313 FORMAT (A2,6X,18A4/(20A4))                                        B11A 133
      DATA IBLANK/2H  /
      TVCF(X)=(SQRT(AMAX1(0.,1.+2.*COSOR*X))-1.)/COSOR
      IF (KR(11)-1) 300,300,301                                         B11A 134
  300 IF(KR(9)) 302,302,307                                             B11A 135
```

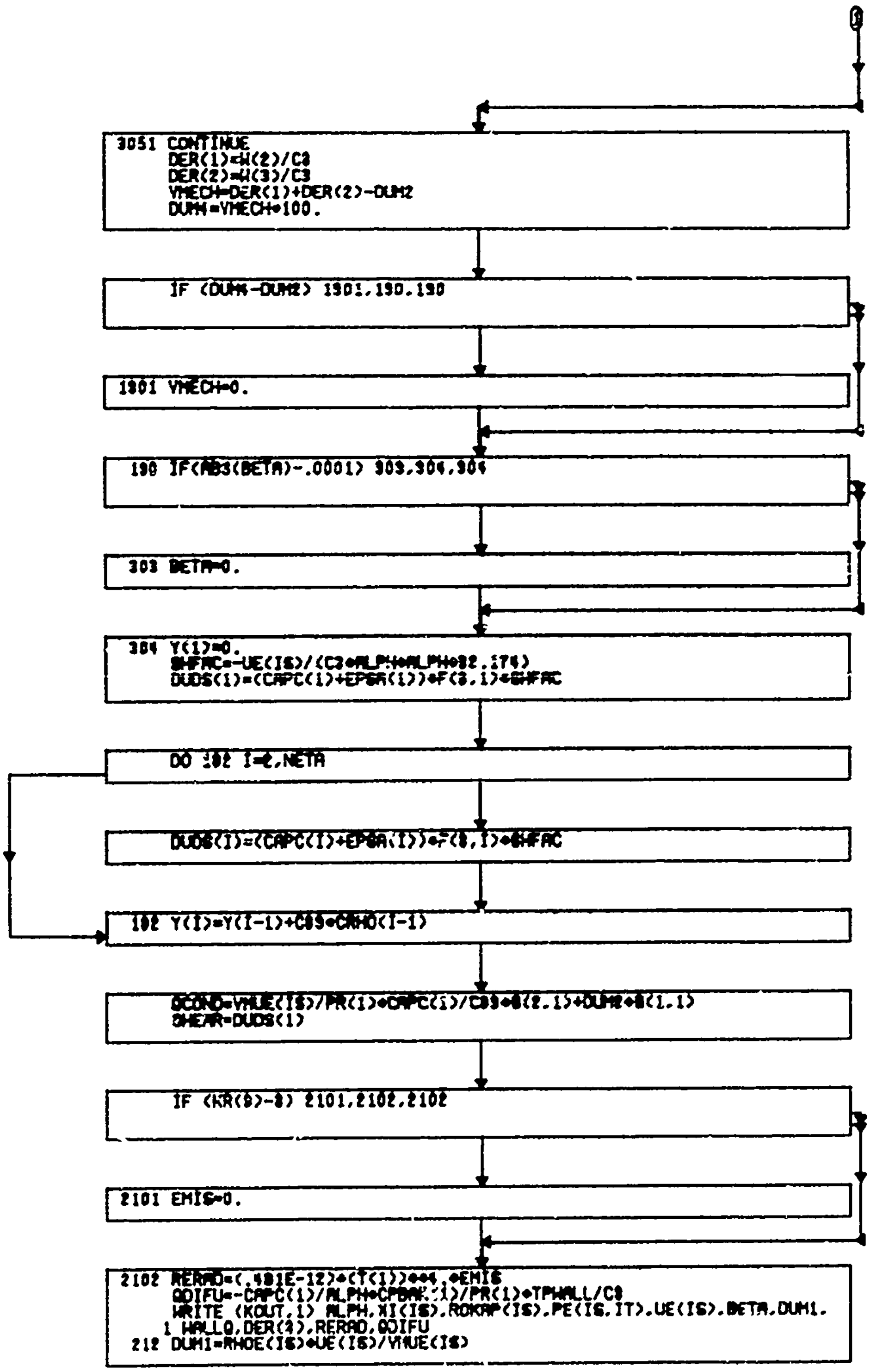
```
  307 IF(KR(9)-2) 301,301,302                                        B11A 136
  302 RHOVW(IS,IT)= C1*F(1,1)   +HF(1,5)                             B11A 137
  301 C89=-C3*ALPH*VMUE(IS)                                          B11A 140
      DUM1=-1./C3                                                    B11A 141
      DUM2=RHOVW(IS,IT)/C3                                           B11A 142
      IF (UE(IS)-1.0) 3012,3011,3012                                 B11A 143
 3011 UE(IS)=0.                                                      B11A 144
 3012 CONTINUE                                                       B11A
      WALLG=-WALLQ/C3                                                B11A 147
      DER(3)=WALLQ-DUM2*G(1,1)                                       B11A 148
      WALLJ(NSP)=0.                                                  B11A 149
      IF (NSPM1) 3051,3051,3050                                      B11A
 3050 DO 305 K=1,NSPM1                                               B11A
      WALLJ(K)=VJKW(K)                                               B11A 151
  305 WALLJ(NSP)=WALLJ(NSP)-WALLJ(K)                                 B11A 152
 3051 CONTINUE                                                       B11A
      DER(1)=W(2)/C3                                                 B11A 153
      DER(2)=W(3)/C3                                                 B11A 154
      VMECH=DER(1)+DER(2)-DUM2                                       B11A 155
      DUM4=VMECH*100.                                                B11A 156
      IF (DUM4-DUM2) 1901,190,190                                    B11A 157
 1901 VMECH=0.                                                       B11A 158
  190 IF(ABS(BETA)-.0001) 303,304,304                                B11A 159
  303 BETA=0.                                                        B11A 160
  304 Y(1)=0.                                                        B11A 161
      SHFAC=-UE(IS)/(C3*ALPH*ALPH*32.174)
      DUDS(1)=(CAPC(1)+EPSA(1))*F(3,1)*SHFAC
      DO 182 I=2,NETA                                                B11A 162
      DUDS(I)=(CAPC(I)+EPSA(I))*F(3,I)*SHFAC
  182 Y(I)=Y(I-1)+C89*CRHO(I-1)                                      B11A 163
      GCOND=VMUE(IS)/PR(1)*CAPC(1)/C89*G(2,1)+DUM2*G(1,1)            B11A 164
      SHEAR=DUDS(1)
      IF (KR(9)-3) 2101,2102,2102
 2101 EMIS=0.
 2102 RERAD=(.481E-12)*(T(1))**4.*EMIS
      QDIFU=-CAPC(1)/ALPH*CPBAR(1)/PR(1)*TPWALL/C3
      WRITE (KOUT,1) ALPH,XI(IS),ROKAP(IS),PE(IS,IT),UE(IS),BETA,DUM1,
     1 WALLQ,DER(3),RERAD,QDIFU
  212 DUM1=RHOE(IS)*UE(IS)/VMUE(IS)                                  B11A 179
      CH= WALLQ  /      (G(1,NETA)-G(1,1))                           B11A 180
      CF=CAPC(1)/ALPH*VMUE(IS)/C89*F(3,1)                            B11A 181
  213 WRITE(KOUT,2) (ATA(K),ATB(K),K=1,NSP)                          B11A 183
      WRITE (KOUT,19)                                                B11A 184
      DUM4=ALPH*ALPH                                                 B11A 185
      DO 203 I=1,NETA                                                B11A 186
      SP(1,I,NSP)=1.0                                                B11A 187
      SP(2,I,NSP)=0.                                                 B11A 188
  203 SP(3,I,NSP)=0.                                                 B11A 189
      IF (NSPM1) 2021,2021,2020                                      B11A
 2020 DO 202 K=1,NSPM1                                               B11A
      DO 202 I=1,NETA                                                B11A 191
      SP(1,I,NSP)=SP(1,I,NSP)-SP(1,I,K)                              B11A 192
      SP(2,I,K)=SP(2,I,K)/ALPH                                       B11A 193
      SP(2,I,NSP)=SP(2,I,NSP)-SP(2,I,K)                              B11A 194
      SP(3,I,K)=SP(3,I,K)/DUM4                                       B11A 195
  202 SP(3,I,NSP)=SP(3,I,NSP)-SP(3,I,K)                              B11A 196
 2021 CONTINUE                                                       B11A
      XSP(5,NSP)=F(1,NETA)-F(1,1)                                    B11A 197
      IF(NSPM1) 2138,2138,2135
 2138 VJKW(1)=0.
```

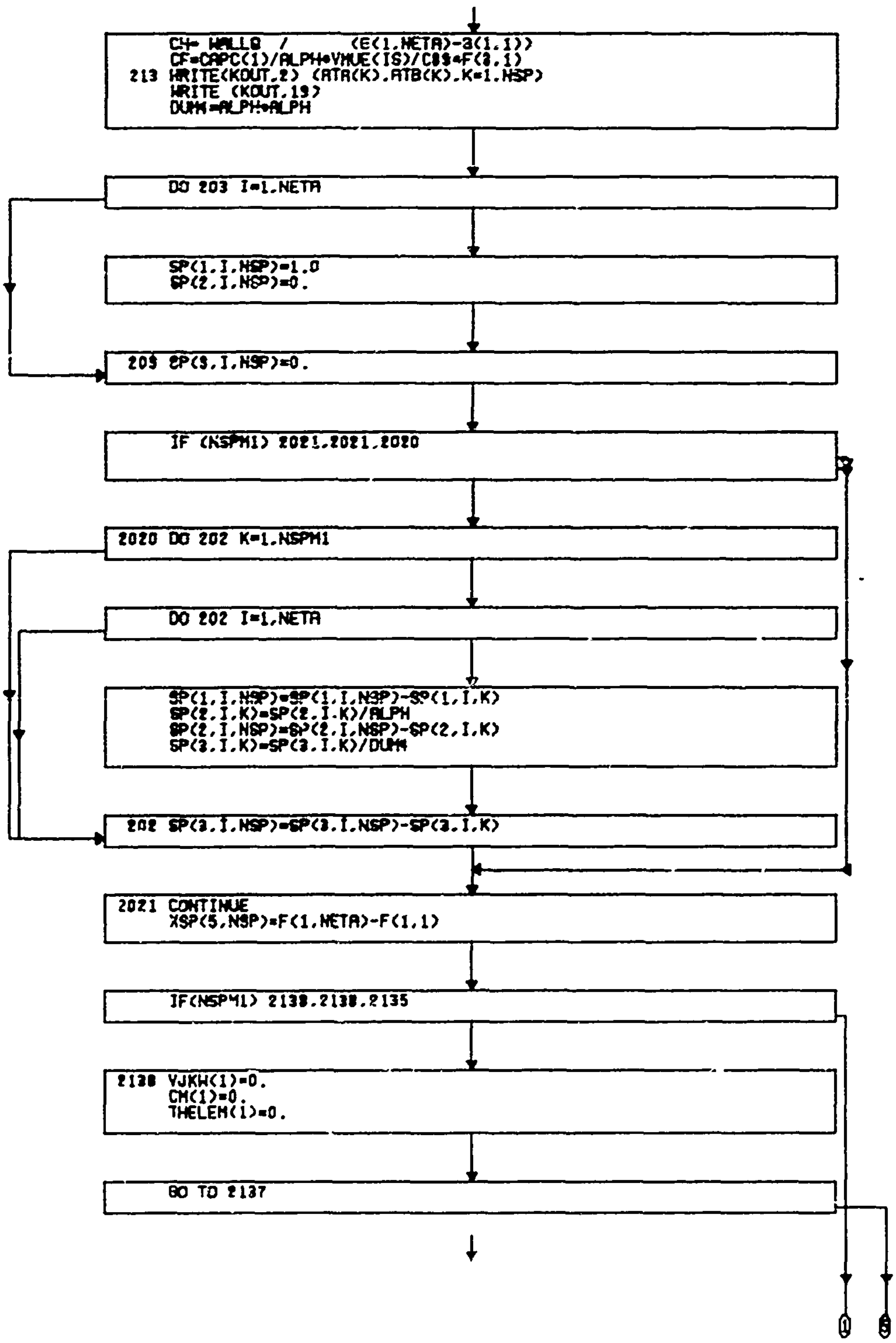
```
            CM(1)=0.
            THELEM(1)=0.
            GO TO 2137
      2135 DO 2136 I=1,NSPM1                                                B11A
      2136 XSP(5,NSP)=XSP(5,NSP)-XSP(5,I)                                   B11A 199
            DO 2131 I=1,NSP                                                 B11A 200
            VJKW(I)=0.                                                      B11A 201
            DO 2132 K=1,NSP                                                 B11A 202
      2132 VJKW(I)=VJKW(I)-WALLJ(K)/WTM(K)*CIJ(I,K)                         B11A 203
      2131 VJKW(I)=VJKW(I)*WAT(I)                                           B11A 204
      2137 CONTINUE
            WRITE(KOUT,3) SHEAR,VMECH,DER(1),DER(2),DUM2,    (VJKW(I),I=1,NSP) B11A 205
       214 RES=DUM1*S(IS)                                                   B11A 206
            DUM3=C89*(F(1,NETA)-F(1,1))/ALPH                                B11A 207
            DELST=Y(NETA)-DUM3                                              B11A 208
            REDELS=DUM1*DELST                                               B11A 209
            THENGY=(DUM3*G(1,NETA)-C89/ALPH*XG(5))/(G(1,NETA)-G(1,1))       B11A 210
            RETHEN=DUM1*THENGY                                              B11A 211
            THMOM=DUM3-C89/ALPH*XM(5)/ALPH                                  B11A 212
            RETHMO=DUM1*THMOM                                               B11A 213
            DELBD=Y(NETA)-C89/ALPH*F(1,NETA)
            THCOND=CPBAR(1)/RHO(1)*RHOE(IS)/G(2,1)*C89*(T(NETA)-T(1))       B11A 215
            BLOW=DUM2/CH                                                    B11A 216
       207 BLOWPG=DER(1)/CH                                                 B11A 218
            BLOWCH=DER(2)/CH                                                B11A 219
            IF(NSPM1) 2074,2074,2070
      2070 DO 2071 I=1,NSP
            THELEM(I)=0.                                                    B11A 221
            DUZ=0.
            DO 2072 K=1,NSP                                                 B11A 223
            DUZ=DUZ+(DUM3*SP(1,NETA,K)-C89/ALPH*XSP(5,K))/WTM(K)*CIJ(I,K)
      2072 THELEM(I)=THELEM(I)+(SP(1,NETA,K)-SP(1,1,K))/WTM(K)*CIJ(I,K)     B11A 226
            CM(I)=VJKW(I)/(THELEM(I)*WAT(I))
      2071 THELEM(I)=DUZ/THELEM(I)
      2074 IF(KG(9)) 2075,2078,2075
      2075 COSOR=-TVCC(IS)/VMUE(IS)*0.5/C3*FLOAT(KG(9))
            DO 2076 I=1,NETA
            Y(I)=TVCF(Y(I))
      2076 DUDS(I)=DUDS(I)*(1.+COSOR*Y(I))
            DELST=TVCF(DELST)
            DELBD=TVCF(DELBD)
            THMOM=TVCF(THMOM)
            THENGY=TVCF(THENGY)
            DO 2077 K=1,NSP
      2077 THELEM(K)=TVCF(THELEM(K))
      2078 CONTINUE
            WRITE(KOUT,18) (ATA(K),ATB(K),K=1,NSP)                          B11A 228
            WRITE (KOUT,3) CF,CH,BLOWPG,BLOWCH,BLOW,(CM(I),I=1,NSP)         B11A 229
            WRITE(KOUT,12)                                                  B11A 232
            WRITE(KOUT,4) (ATA(K),ATB(K),K=1,NSP)                           B11A 233
            WRITE(KOUT,20) THMOM,DELST,DELBD,THENGY,DUM1,(THELEM(K),K=1,NSP)
       209 WRITE(KOUT,5)                                                    B11A 238
            WRITE(KOUT,6)                                                   B11A 239
            DO 183 I=1,NETA                                                 B11A 240
C           COMPUTE TRUE VALUES OF F(I,J) AND ETA                           B11A 241
            DER(1)=F(1,I)
            DER(2)=F(2,I)/ALPH
            DER(3)=F(3,I)/DUM4
            DER(4)=DUDS(I)
            DER(5)=G(1,I)
```

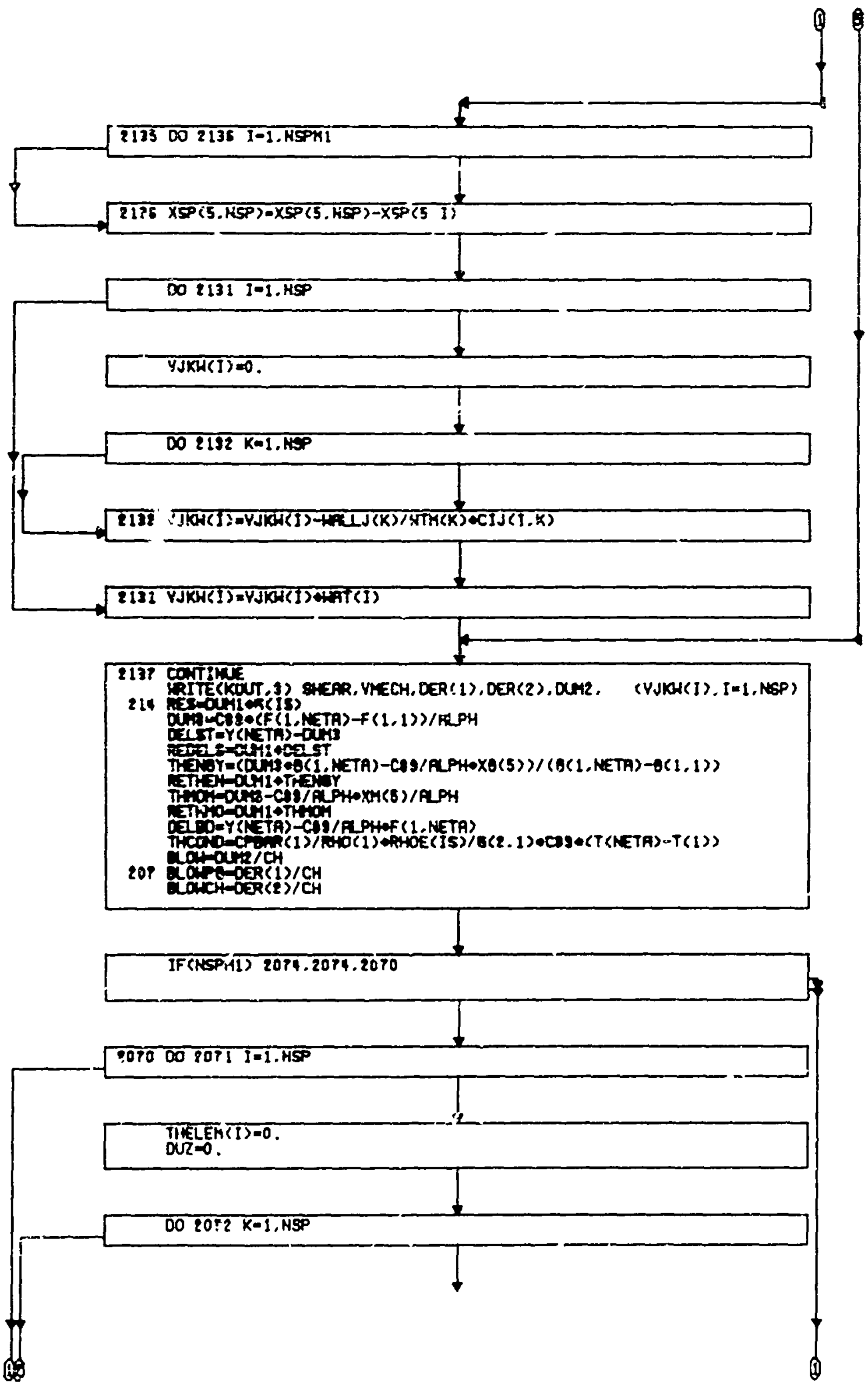
```
      DER(6)=G(2,I)/ALPH
      DER(7)=G(3,I)/DUM4
      RETA=ETA(I)*ALPH
      DER(8)=5.614E+12*PE(IS,IT)/SQRT(T(I)/1.8)
  183 WRITE(KOUT,3) Y(I),RETA,(DER(J),J=1,7),
     1 W(I),T(I),DER(8)
      WRITE(KOUT,12)                                                    B11A 250
  216 WRITE(KOUT,7)                                                     B11A 258
      DO 184 I=1,NETA                                                   B11A 259
      COND=CPBAR(I)/PR(I)*VMU(I)                                        B11A 260
      GMR(I)=ABS(GMR(I))
      ACH=F(2,I)/ALPH*UE(IS)/SQRT(GMR(I)/VMW(I)*T(I)*49732.)
  184 WRITE(KOUT,3)Y(I),RHO(I),VMU(I),CAPC(I),CPBAR(I),COND,PR(I),SC(I),B11A 261
     1 VMW(I),EPSA(I),ACH
      IF (KR(7).EQ.1) GO TO 193
      WRITE(KOUT,13)(Y(I),I=1,NETA)                                     B11A 263
      WRITE(KOUT, 8)                                                    B11A 264
      DO 201 K=1,NSP                                                    B11A 265
      WRITE (KOUT,14) MOA(K),MOB(K),(SP(1,I,K),I=1,NETA)                B11A 266
      WRITE (KOUT,15)(SP(2,I,K),I=1,NETA)                               B11A 267
  201 WRITE (KOUT,15)(SP(3,I,K),I=1,NETA)                               B11A 268
      IF (NSPM1) 2041,2041,2040                                         B11A
 2040 DO 204 K=1,NSPM1                                                  B11A
      DO 204 I=1,NETA                                                   B11A 270
      SP(2,I,K)=SP(2,I,K)*ALPH                                          B11A 271
  204 SP(3,I,K)=SP(3,I,K)*DUM4                                          B11A 272
 2041 CONTINUE                                                          B11A
      WRITE (KOUT,16)                                                   B11A 273
      DO 196 J=1,NSPEC                                                  B11A 274
  196 WRITE(KOUT,14) MOA(J),MOB(J),(FR(J,I),I=1,NETA)                   B11A 275
      IF(KR(9).EQ.3.OR.KR(9).EQ.4) WRITE(KOUT,17) MOA(ISU),MOB(ISU)
  193 CONTINUE                                                          B11A 276
  325 WALLG=-WALLQ*C3
      RETURN
      END                                                               B11A 307
```

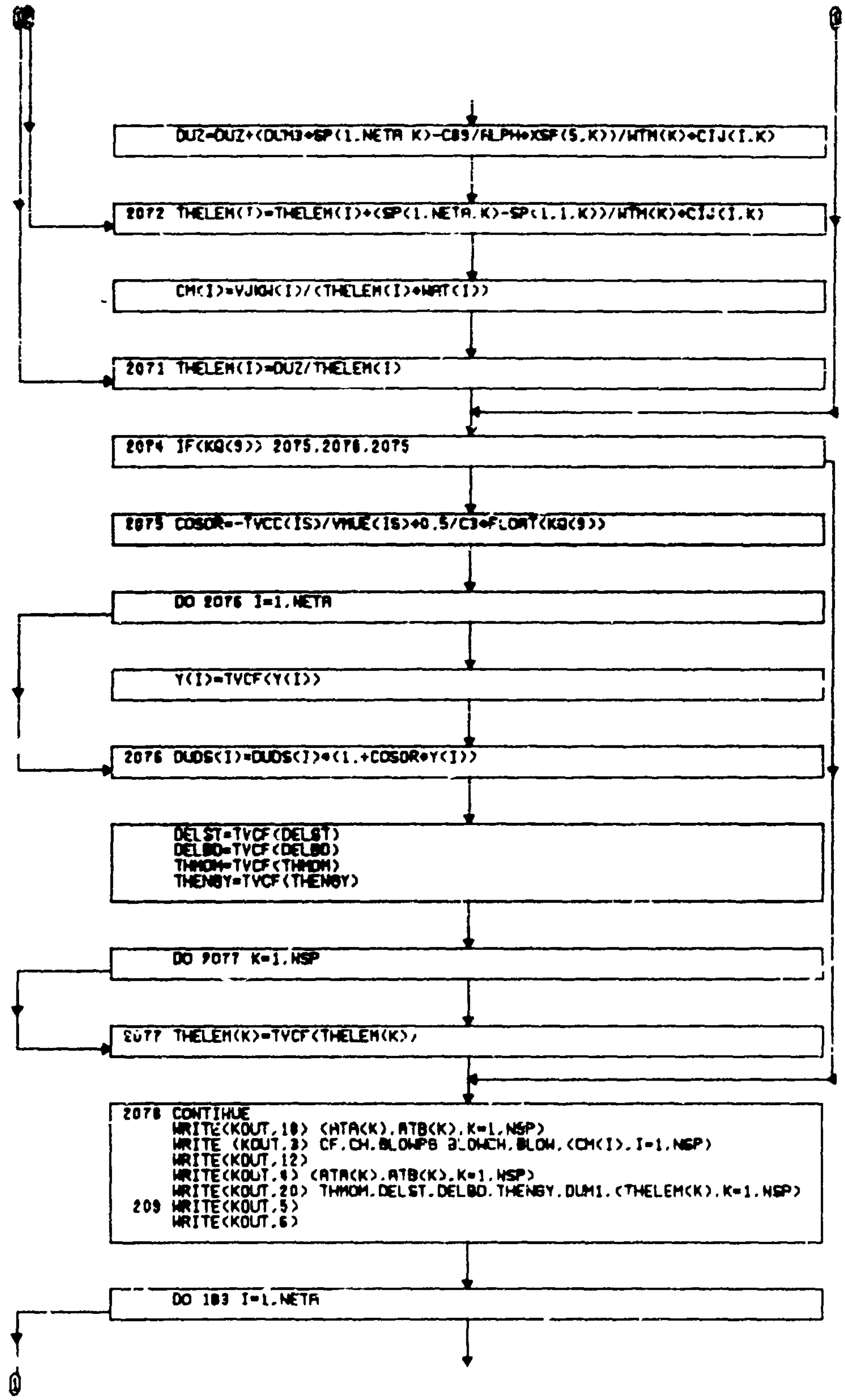
c. Flow Chart


C311A
SUBROUTINE OUTPUT
DATA IBLANK/2H /
TVCF(X)=(SQRT(AMAX1(0.,1.+2.*COSOR*X))-1.)/COSOR
IF (KR(11)-1) 300,300,301
300 IF(KR(3)) 302,302,307
307 IF(KR(3)-2) 301,301,302
302 RHOVH(IS,IT)= C1*F(1,1) +HF(1,5)
301 C3=-C3*ALPH*VMUE(IS)
DUM1=-1./C3
DUM2=RHOVH(IS,IT)/C3
IF (UE(IS)-1.0) 3012,3011,3012
3011 UE(IS)=0.
3012 CONTINUE
WALLQ=-WALLQ/C3
DER(3)=WALLQ-DUM2*B(1,1)
WALLJ(NSP)=0.
IF (NSPM1) 3051,3051,3050
3050 DO 305 K=1,NSPM1
WALLJ(K)=VJKW(K)
305 WALLJ(NSP)=WALLJ(NSP)-WALLJ(K)
1

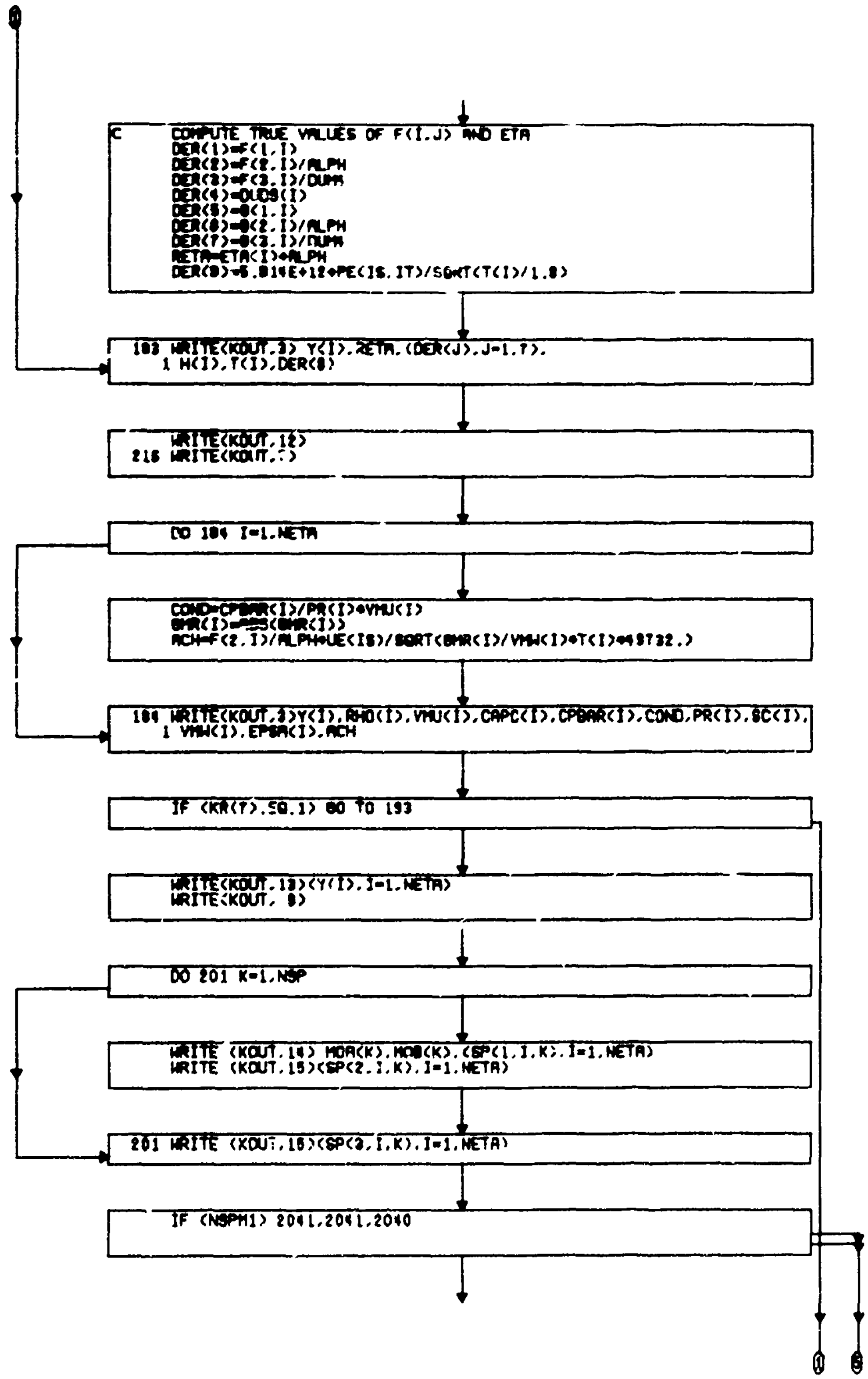

0
3051 CONTINUE
DER(1)=W(2)/C3
DER(2)=W(3)/C3
VMECH=DER(1)+DER(2)-DUM2
DUM4=VMECH*100.
IF (DUM4-DUM2) 1301,130,130
1301 VMECH=0.
130 IF(ABS(BETA)-.0001) 303,304,304
303 BETA=0.
304 Y(1)=0.
SHFAC=-UE(IS)/(C3*ALPH*ALPH*32.174)
DUDS(1)=(CAPC(1)+EPSA(1))*F(3,1)*SHFAC
DO 102 I=2,NETA
DUDS(I)=(CAPC(I)+EPSA(I))*F(3,I)*SHFAC
102 Y(I)=Y(I-1)+C39*CRHO(I-1)
QCOND=VMUE(IS)/PR(1)*CAPC(1)/C39*G(2,1)+DUM2*G(1,1)
SHEAR=DUDS(1)
IF (KR(9)-8) 2101,2102,2102
2101 EMIS=0.
2102 RERAD=(.481E-12)*(T(1))**4.*EMIS
QDIFU=-CAPC(1)/ALPH*CPBAR(1)/PR(1)*TPWALL/C8
WRITE (KOUT,1) ALPH,XI(IS),ROKAP(IS),PE(IS,IT),UE(IS),BETA,DUM1,
1 WALLQ,DER(2),RERAD,QDIFU
212 DUM1=RHOE(IS)*UE(IS)/VMUE(IS)

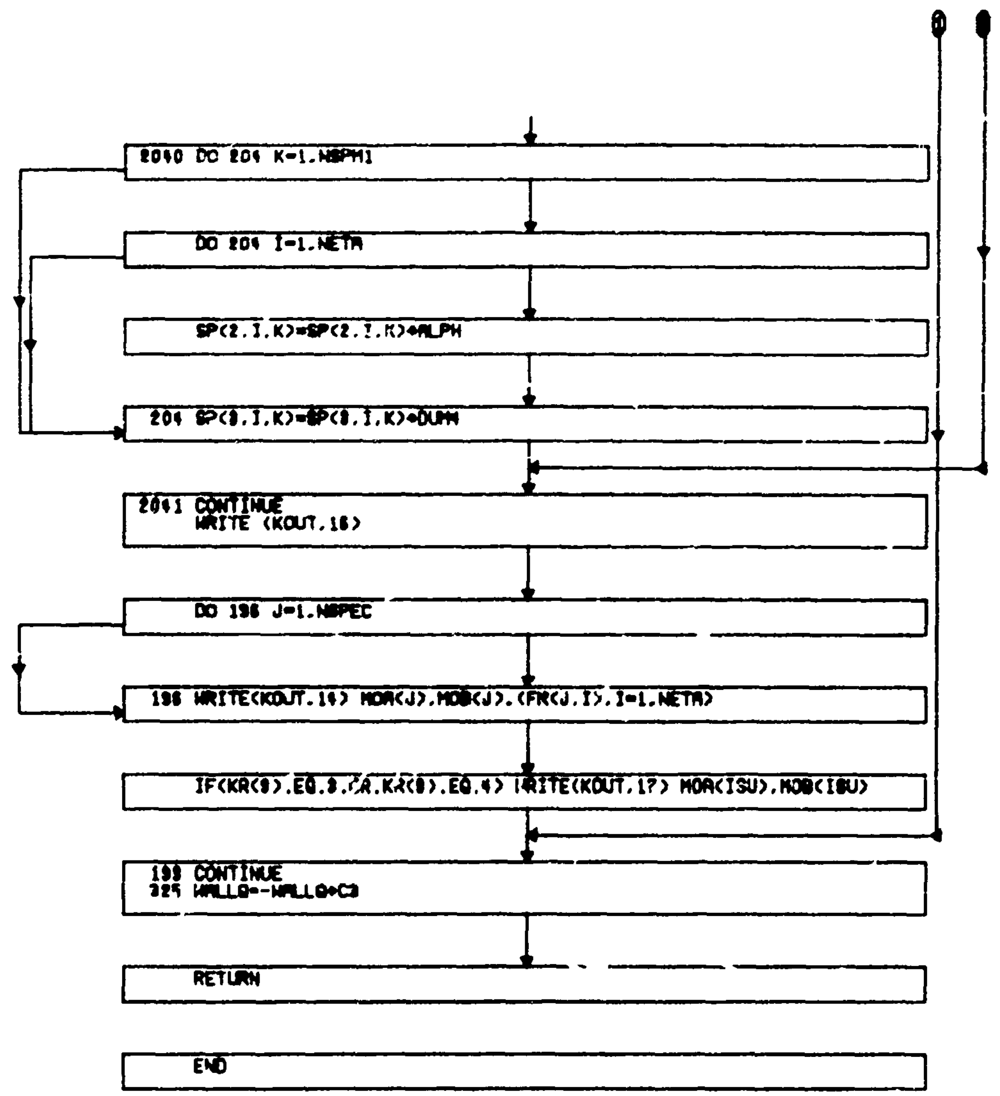

CH= WALLS / (E(1.NETA)-3(1.1))
CF=CAPC(1)/ALPH*VMUE(IS)/C8$*F(3.1)
213 WRITE(KOUT.2) (ATA(K).ATB(K).K=1.NSP)
WRITE (KOUT.19)
DUMM=ALPH*ALPH
DO 203 I=1.NETA
SP(1.I.NSP)=1.0
SP(2.I.NSP)=0.
203 SP(3.I.NSP)=0.
IF (NSPM1) 2021.2021.2020
2020 DO 202 K=1.NSPM1
DO 202 I=1.NETA
SP(1.I.NSP)=SP(1.I.NSP)-SP(1.I.K)
SP(2.I.K)=SP(2.I.K)/ALPH
SP(2.I.NSP)=SP(2.I.NSP)-SP(2.I.K)
SP(3.I.K)=SP(3.I.K)/DUMM
202 SP(3.I.NSP)=SP(3.I.NSP)-SP(3.I.K)
2021 CONTINUE
XSP(5.NSP)=F(1.NETA)-F(1.1)
IF(NSPM1) 2138.2138.2135
2138 VJKW(1)=0.
CM(1)=0.
THELEM(1)=0.
GO TO 2137


2135 DO 2136 I=1,NSPM1
2136 XSP(5,NSP)=XSP(5,NSP)-XSP(5,I)
DO 2131 I=1,NSP
VJKW(I)=0.
DO 2132 K=1,NSP
2132 VJKW(I)=VJKW(I)-WALLJ(K)/WTM(K)*CIJ(I,K)
2131 VJKW(I)=VJKW(I)*WAT(I)
2137 CONTINUE
WRITE(KOUT,3) SHEAR,VMECH,DER(1),DER(2),DUM2, (VJKW(I),I=1,NSP)
214 RES=DUM1*R(IS)
DUM3=C89*(F(1,NETA)-F(1,1))/ALPH
DELST=Y(NETA)-DUM3
REDELS=DUM1*DELST
THENBY=(DUM3*B(1,NETA)-C89/ALPH*XB(5))/(B(1,NETA)-B(1,1))
RETHEN=DUM1*THENBY
THMOM=DUM3-C89/ALPH*XM(5)/ALPH
RETHMO=DUM1*THMOM
DELBO=Y(NETA)-C89/ALPH*F(1,NETA)
THCOND=CPBAR(1)/RHO(1)*RHOE(IS)/B(2,1)*C89*(T(NETA)-T(1))
BLOW=DUM2/CH
207 BLOWPG=DER(1)/CH
BLOWCH=DER(2)/CH
IF(NSPM1) 2074,2074,2070
2070 DO 2071 I=1,NSP
THELEM(I)=0.
DUZ=0.
DO 2072 K=1,NSP



DUZ=DUZ+(DLM3*SP(1.NETA K)-C89/ALPH*XSF(5.K))/WTM(K)*CIJ(I.K)
2072 THELEM(I)=THELEM(I)+(SP(1.NETA.K)-SP(1.1.K))/WTM(K)*CIJ(I.K)
CM(I)=VJIGW(I)/(THELEM(I)*WAT(I))
2071 THELEM(I)=DUZ/THELEM(I)
2074 IF(KQ(9)) 2075.2078.2075
2075 COSOR=-TVCC(IS)/VMUE(IS)*0.5/C3*FLOAT(KQ(9))
DO 2076 I=1.NETA
Y(I)=TVCF(Y(I))
2076 DUDS(I)=DUDS(I)*(1.+COSOR*Y(I))
DELST=TVCF(DELST)
DELBD=TVCF(DELBD)
THMOM=TVCF(THMOM)
THENGY=TVCF(THENGY)
DO 2077 K=1.NSP
2077 THELEM(K)=TVCF(THELEM(K))
2078 CONTINUE
WRITE(KOUT.18) (ATA(K).ATB(K).K=1.NSP)
WRITE (KOUT.3) CF.CH.BLOWPB BLOWCH.BLOW.(CM(I).I=1.NSP)
WRITE(KOUT.12)
WRITE(KOUT.4) (ATA(K).ATB(K).K=1.NSP)
WRITE(KOUT.20) THMOM.DELST.DELBD.THENGY.DUM1.(THELEM(K).K=1.NSP)
209 WRITE(KOUT.5)
WRITE(KOUT.6)
DO 183 I=1.NETA


C COMPUTE TRUE VALUES OF F(I,J) AND ETA
DER(1)=F(1,I)
DER(2)=F(2,I)/ALPH
DER(3)=F(3,I)/DUMM
DER(4)=OLDS(I)
DER(5)=G(1,I)
DER(6)=G(2,I)/ALPH
DER(7)=G(3,I)/DUMM
RETA=ETA(I)*ALPH
DER(8)=5.814E+12*PE(IS,IT)/SQRT(T(I)/1.8)
193 WRITE(KOUT,3) Y(I),RETA,(DER(J),J=1,7),
1 H(I),T(I),DER(8)
WRITE(KOUT,12)
216 WRITE(KOUT,7)
DO 194 I=1,NETA
COND=CPBAR(I)/PR(I)*VMU(I)
GMR(I)=ABS(GMR(I))
ACH=F(2,I)/ALPH*UE(IS)/SQRT(GMR(I)/VMW(I)*T(I)*49732.)
194 WRITE(KOUT,3)Y(I),RHO(I),VMU(I),CAPC(I),CPBAR(I),COND,PR(I),SC(I),
1 VMW(I),EPSA(I),ACH
IF (KR(7).EQ.1) GO TO 193
WRITE(KOUT,13)(Y(I),I=1,NETA)
WRITE(KOUT, 9)
DO 201 K=1,NSP
WRITE (KOUT,14) MOA(K),MOB(K),(SP(1,I,K),I=1,NETA)
WRITE (KOUT,15)(SP(2,I,K),I=1,NETA)
201 WRITE (KOUT,16)(SP(3,I,K),I=1,NETA)
IF (NSPM1) 2041,2041,2040


2040 DO 204 K=1.NSPM1
DO 204 I=1.NETA
SP(2.I.K)=SP(2.I.K)+ALPH
204 SP(3.I.K)=SP(3.I.K)+DUMH
2041 CONTINUE
WRITE (KOUT.16)
DO 196 J=1.NSPEC
196 WRITE(KOUT.14) MOR(J).MOB(J).(FN(J.I).I=1.NETA)
IF(KR(9).EQ.3.OR.KR(9).EQ.4) WRITE(KOUT.17) MOR(ISU).MOB(ISU)
199 CONTINUE
325 WALLQ=-WALLQ+C3
RETURN
END

12. SUBROUTINE IMONE - B12B

a. Function

Evaluates the coefficients of the (I-1) th corrections for the I nonlinear (conservation) equations, where I is the I th nodal point in the boundary layer. Called by NONCER. Calls TAYLOR.

b. Listing

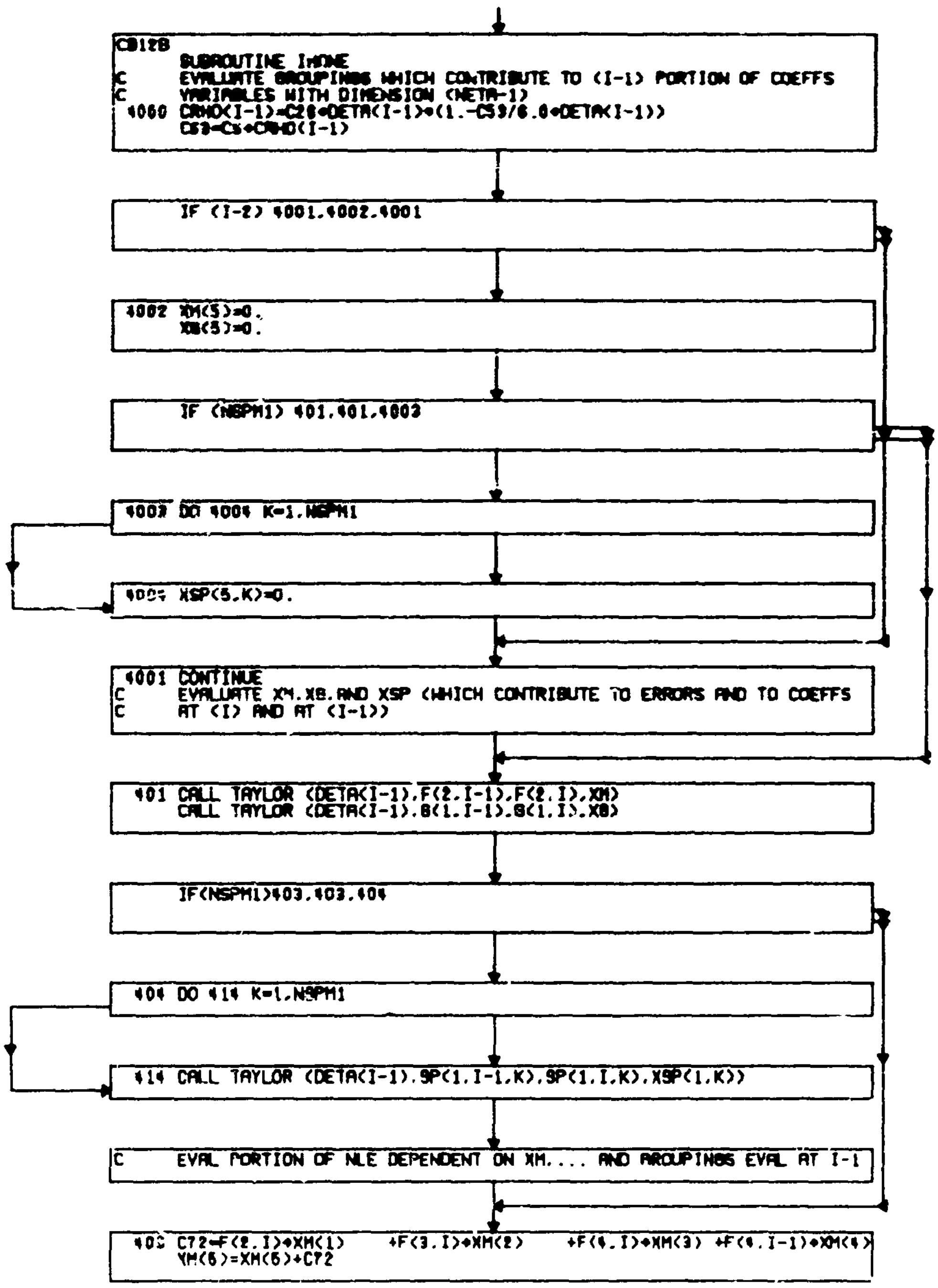
```
      C9128                                                             B128 001
      SUBROUTINE IMONE                                                  B128 002
      COMMON/COFCOM/                 C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B128   3*NEW
     1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB128   4*NEW
     232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C48B128   5*NEW
     3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB128   6*NEW
     465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81B128   7*NEW
     5,C82,C83,C84,C85,C86,C87,C88                                      B128   8*NEW
      COMMON/CKFCOM/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)    B128   9*NEW
     1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)      B128  10*NEW
     2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)   B128  11*NEW
     3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9)  B128  12*NEW
     4,CKK3( 8, 8)                                                      B128  13*NEW
      COMMON/ERRCOM/ELE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM     B128  14*NEW
     1,SPLEM( 8),ELM(14),FLMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)     B128  15*NEW
     2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)      B128  16*NEW
     3,FNLEM,GNLEM,SPNLEM( 8),              ENLMM,IFNLM,IGNLM,ISPNLM( 8)B128  17*NEW
     4,IENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(13)              B128  18*NEW
      COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),R1(14),R2(14)      B128  19*NEW
     1,LAR(153),BA1(43,18),BA2(30,15)                                   B128  20*NEW
      COMMON/MISCOM/C1,C2,C3,C4,ALPHD,BETA,ZF(4,14),ZG(4,14),ZSP(4,14, 8B128  21*NEW
     1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B128  22*NEW
     2,C3M(40),FETAM(40)                                                B128  23*NEW
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB128  24*NEW
     1S,IT,NTIME,NSP,NSPM1,NAM,NLFQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B128  25*NEW
     2,R(8),       MWE,MON,K9(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40)B128  26*NEW
     3,KAUXO,JTIME,JSPEC,MD(3)                                          B128  27*NEW
      COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                          B128  28*NEW
     1VINKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)               B128  29*NEW
      COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)   B128  30*NEW
     1,CPBAR(15),VMU(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB128  31*NEW
     2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B128  32*NEW
     3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)   B128  33*NEW
     4,DPHIKK( 8, 8),          DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL B128  34*NEW
     5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),   RHOP B128  35*NEW
     6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B128  36*NEW
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B128  37*NEW
C     EVALUATE GROUPINGS WHICH CONTRIBUTE TO (I-1) PORTION OF COEFFS    B128 041*-35
C     VARIABLES WITH DIMENSION (NETA-1)                                 B128 042
 4000 CRHO(I-1)=C26*DETA(I-1)*(1.-C93/6.0*DETA(I-1))                    B128 044
      C63=C6*CRHO(I-1)                                                  B128 045
      IF (I-2) 4001,4002,4001                                           B128 052
 4002 XM(5)=0.                                                          B128 053
      XG(5)=0.                                                          B128 054
      IF (NSPM1) 401,401,4003                                           B128 055
 4003 DO 4004 K=1,NSPM1                                                 B128 056
 4004 XSP(5,K)=0.                                                       B128 057
 4001 CONTINUE
C     EVALUATE XM,XG,AND XSP  WHICH CONTRIBUTE TO ERRORS AND TO COEFFS  B128 065
C     AT (I) AND AT (I-1))                                              B128 066
  401 CALL TAYLOR (DETA(I-1),F(2,I-1),F(2,I),XM)                        B128 067
      CALL TAYLOR (DETA(I-1),G(1,I-1),G(1,I),XG)                        B128 068
      IF(NSPM1)403,403,404                                              B128 069
  404 DO 414 K=1,NSPM1                                                  B128 070
  414 CALL TAYLOR (DETA(I-1),SP(1,I-1,K),SP(1,I,K),XSP(1,K))            B128 071
C     EVAL PORTION OF NLE DEPENDENT ON XM,... AND GROUPINGS EVAL AT I-1 B128 072
  403 C72=F(2,I)*XM(1)     +F(3,I)*XM(2)     +F(4,I)*XM(3) +F(4,I-1)*XM(4)B128 073
      XM(5)=XM(5)+C72                                                   B128 074
```

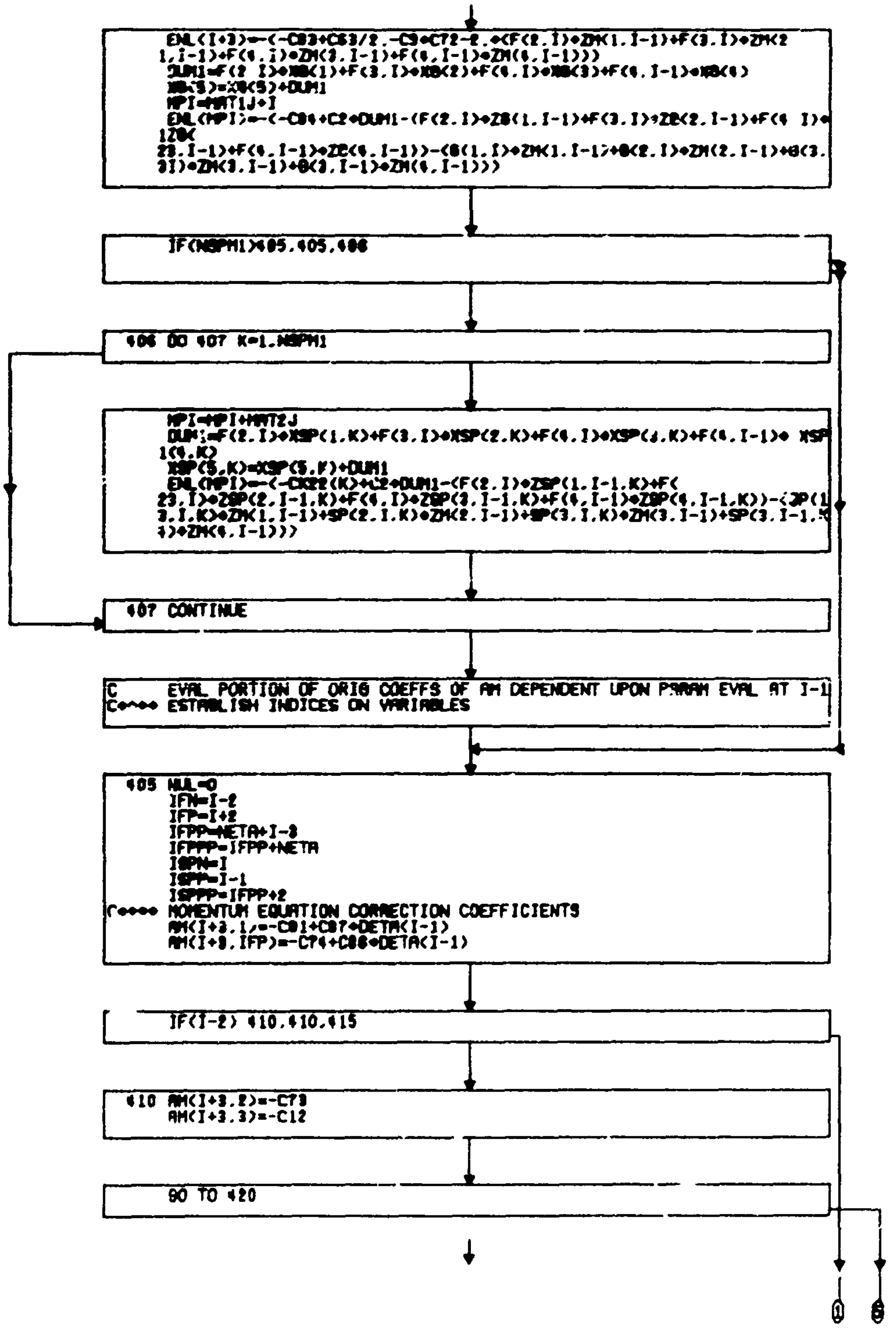
```
      ENL(I+3)=-(-C83+C73/2.-C9*C72-2.*(F(2,I)*ZM(1,I-1)+F(3,I)*ZM(2
     1,I-1)+F(4,I)*ZM(3,I-1)+F(4,I-1)*ZM(4,I-1)))                       B12A 076
      DUM1=F(2,I)*XG(1)+F(3,I)*XG(2)+F(4,I)*XG(3)+F(4,I-1)*XG(4)        B12A 077
      XG(5)=XG(5)+DUM1                                                  B12A 078
      MPI=MAT1J+I
      ENL(MPI)=-(-C84+C2*DUM1-(F(2,I)*ZG(1,I-1)+F(3,I)*ZG(2,I-1)+F(4,I)*
     1ZG(                                                               B12A 080
     23,I-1)+F(4,I-1)*ZG(4,I-1))-(G(1,I)*ZM(1,I-1)+G(2,I)*ZM(2,I-1)+G(3,B12A 081
     3I)*ZM(3,I-1)+G(3,I-1)*ZM(4,I-1)))                                 B12A 082
      IF(NSPM1)405,405,406                                              B12A 085
  406 DO 407 K=1,NSPM1
      MPI=MPI+MAT2J
      DUM1=F(2,I)*XSP(1,K)+F(3,I)*XSP(2,K)+F(4,I)*XSP(3,K)+F(4,I-1)* XSPB12A 087
     1(4,K)                                                             B12A 088
      XSP(5,K)=XSP(5,K)+DUM1                                            B12A 089
      ENL(MPI)=-(-CK22(K)+C2*DUM1-(F(2,I)*ZSP(1,I-1,K)+F(
     23,I)*ZSP(2,I-1,K)+F(4,I)*ZSP(3,I-1,K)+F(4,I-1)*ZSP(4,I-1,K))-(SP(1B12A 091
     3,I,K)*ZM(1,I-1)+SP(2,I,K)*ZM(2,I-1)+SP(3,I,K)*ZM(3,I-1)+SP(3,I-1,KB12A 092
     4)*ZM(4,I-1)))                                                     B12A 093
  407 CONTINUE
C     EVAL PORTION OF ORIG COEFFS OF AM DEPENDENT UPON PARAM EVAL AT I-1B12A 096
C**** ESTABLISH INDICES ON VARIABLES
  405 NUL=0
      IFN=I-2
      IFP=I+2
      IFPP=NETA+I-3
      IFPPP=IFPP+NETA
      ISPN=I
      ISPP=I-1
      ISPPP=IFPP-2
C**** MOMENTUM EQUATION CORRECTION COEFFICIENTS
      AM(I+3,1)=-C81+C87*DETA(I-1)
      AM(I+3,IFP)=-C74+C86*DETA(I-1)
      IF(I-2) 410,410,415
  410 AM(I+3,2)=-C73
      AM(I+3,3)=-C12
      GO TO 420
  415 CALL LIAD(-1,I+3,IFN,-C73)
      CALL LIAD(-1,I+3,IFPP,-C12)
  420 CALL LIAD(-1,I+3, IFPPP,-2.*(C9 * XM(4)+ZM(4,I-1)))
      LPI=ISPN+MAT1J
      DO 450 K=NUL, NSPM1
      IF(K) 425,425,430
  425 DUM1=C88*DETA(I-1)-C75
      DUM2=0.
      GO TO 435
  430 DUM1=CK13(K)*DETA(I-1)-CK17(K)
      DUM2=0.
  435 AM(I+3,LPI)=DUM1
      IF(I-2) 440,440,445
  440 AM(I+3,LPI-1) = DUM2
      GO TO 450
  445 CALL LIAD(K,I+3, ISPP, DUM2)
  450 LPI=LPI+MAT2J
C**** ENERGY AND SPECIES EQUATIONS
      MPJ=MAT1J+I
      DO 535 K=NUL, NSPM1
C* *  ALF, F, FP, FPP, FPP ERROR DERIVITIVES ARE DUM1 TO DUM5. DUM6 TO
C* *  DUM8 ARE FLUX DERIVITIVES FOR ALF, FP, FPP.
      IF(K) 455,455,460
```

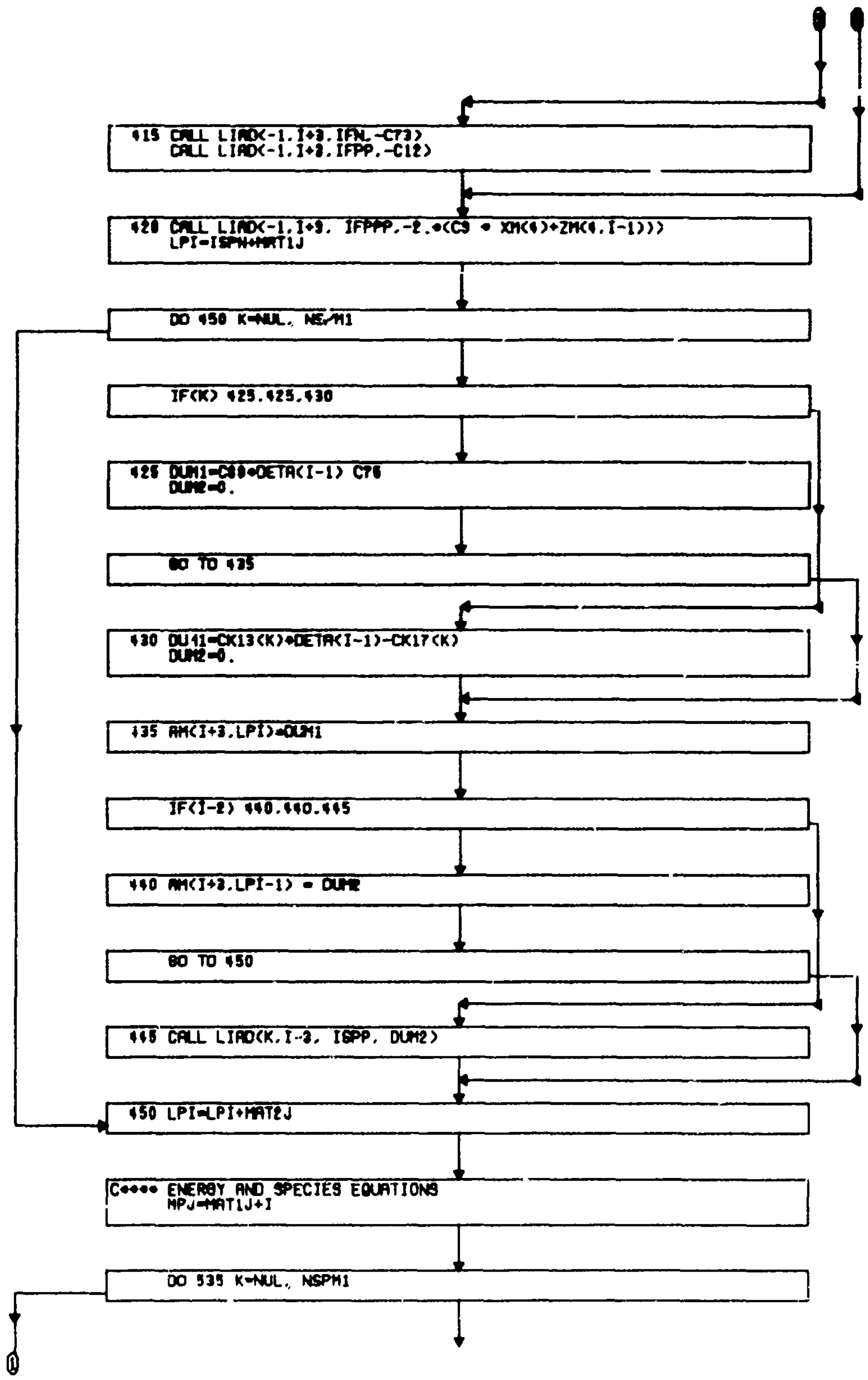
```
C- -  ENERGY EQUATIONS
  455 DUM1=-C82
      DUM2=-C76
      DUM3=-C77
      DUM4=-C78
      DUM6=C62
      DUM7=C77
      DUM8=C78
      GO TO 465
C- -  SPECIES EQUATIONS
  460 DUM1=-(CK21(K)+2.*C56 *CK15(K))
      DUM2=-CK14(K)
      DUM3=-CK19(K)+CK15(K)
      DUM4=-CK20(K)+C10*CK14(K)
      DUM6=CK21(K)
      DUM7=CK19(K)
      DUM8=CK20(K)
  465 DUM5=C2 *ZSP(4,K)-ZSP(4,I-1,K)
      AM(MPJ,1)=DUM1
      AM(MPJ,IFP)= DUM3
      IF(I-2) 470,470,472
  470 AM(MPJ,2)=DUM2
      AM(MPJ,3)= DUM4
      AM(MPJ-1,1)= DUM6
      AM(MPJ-1, IFP)= DUM7
      AM(MPJ-1,3)= DUM8
      GO TO 475
  472 CALL LIAD(-1,MPJ,IFN,DUM2)
      CALL LIAD(-1, MPJ, IFPP, DUM4)
  475 CALL LIAD(-1,MPJ, IFPPP, DUM5)
      LOI= ISP+MAT1J
      DO 530 KK=NUL, NSPM1
C * * DUM1/DUM4 AND DUM2/DUM5 ARE ERROR/FLUX DERIVATIVES WRT G OR SP AND
C * * GP OR SPP, RESP.
      IF(K+KK) 480,480,485
C - - ENERGY EQ, G VARIABLES
  480 DUM2=-C80
      DUM4=C43
      DUM5=C60
      GO TO 515
  485 IF(K) 490,490,495
C - - ENERGY EQUATION, SP VARIABLES
  490 DUM1=-CK1(KK)
      DUM2=-CK2(KK)
      DUM4=-DUM1
      DUM5=-DUM2
      GO TO 508
  495 IF(KK) 500,500,505
C - - SPECIES EQS , G VARIABLES
  500 DUM1=-CK9(K)
      DUM2=-CK5(K) + CK14(K)
      DUM4=CK9(K)
      DUM5=CK5(K)
      GO TO 508
C - - SPECIES EQS., SP VARIABLES
  505 DUM1=-CKK2(K,KK)
      DUM2=-CKK1(K,KK)+B1(I-1)*CKK3(K,KK)
      DUM4=-DUM1
      DUM5=CKK1(K,KK)
      IF(K-KK) 508,515,508
```

```
515 DUM1=-DUM4-C14
500 AM(MPJ,LPI)=DUM1
    IF(I-2) 510,510,525
510 AM(MPJ, LPI-1)= DUM2
520 AM(MPJ-1, LPI) =DUM4
    AM(MPJ-1,LPI-1)=DUM5
    GO TO 530
525 CALL LIAD(KK,MPJ, ISPP, DUM2)
530 LPI=LPI+ AT2J
    CALL LIAD(K,MPJ,ISPPP,C2 *XM(4)-ZM(4,I-1))
535 MPJ=MPJ+MAT2J
    RETURN
    END
```

c. Flow Chart


C812B
SUBROUTINE IMONE
C EVALUATE GROUPINGS WHICH CONTRIBUTE TO (I-1) PORTION OF COEFFS
C VARIABLES WITH DIMENSION (NETA-1)
4060 CRHO(I-1)=C28*DETA(I-1)*(1.-C59/6.0*DETA(I-1))
C59=C5+CRHO(I-1)
IF (I-2) 4001,4002,4001
4002 XM(5)=0.
XB(5)=0.
IF (NSPM1) 401,401,4003
4003 DO 4004 K=1,NSPM1
4004 XSP(5,K)=0.
4001 CONTINUE
C EVALUATE XM,XB,AND XSP (WHICH CONTRIBUTE TO ERRORS AND TO COEFFS
C AT (I) AND AT (I-1))
401 CALL TAYLOR (DETA(I-1),F(2,I-1),F(2,I),XM)
CALL TAYLOR (DETA(I-1),B(1,I-1),B(1,I),XB)
IF(NSPM1)403,403,404
404 DO 414 K=1,NSPM1
414 CALL TAYLOR (DETA(I-1),SP(1,I-1,K),SP(1,I,K),XSP(1,K))
C EVAL PORTION OF NLE DEPENDENT ON XM.... AND GROUPINGS EVAL AT I-1
403 C72=F(2,I)*XM(1) +F(3,I)*XM(2) +F(4,I)*XM(3) +F(4,I-1)*XM(4)
XM(6)=XM(6)+C72


ENL(I+3)=-(-C83+C63/2.-C9*C72-2.*(F(2,I)*ZM(1,I-1)+F(3,I)*ZM(2
1,I-1)+F(4,I)*ZM(3,I-1)+F(4,I-1)*ZM(4,I-1)))
DUM1=F(2,I)*XB(1)+F(3,I)*XB(2)+F(4,I)*XB(3)+F(4,I-1)*XB(4)
XB(5)=XB(5)+DUM1
MPI=MAT1J+I
ENL(MPI)=-(-C84+C2*DUM1-(F(2,I)*ZB(1,I-1)+F(3,I)*ZB(2,I-1)+F(4,I)*
1ZB(
23,I-1)+F(4,I-1)*ZB(4,I-1))-(B(1,I)*ZM(1,I-1)+B(2,I)*ZM(2,I-1)+B(3,
3I)*ZM(3,I-1)+B(3,I-1)*ZM(4,I-1)))
IF(NSPM1)405,405,406
406 DO 407 K=1,NSPM1
MPI=MPI+MAT2J
DUM1=F(2,I)*XSP(1,K)+F(3,I)*XSP(2,K)+F(4,I)*XSP(3,K)+F(4,I-1)* XSP
1(4,K)
XSP(5,K)=XSP(5,K)+DUM1
ENL(MPI)=-(-CX22(K)+C2*DUM1-(F(2,I)*ZSP(1,I-1,K)+F(
23,I)*ZSP(2,I-1,K)+F(4,I)*ZSP(3,I-1,K)+F(4,I-1)*ZSP(4,I-1,K))-(SP(1
3,I,K)*ZM(1,I-1)+SP(2,I,K)*ZM(2,I-1)+SP(3,I,K)*ZM(3,I-1)+SP(3,I-1,K
4)*ZM(4,I-1)))
407 CONTINUE
C EVAL PORTION OF ORIG COEFFS OF AM DEPENDENT UPON PARAM EVAL AT I-1
C**** ESTABLISH INDICES ON VARIABLES
405 NUL=0
IFN=I-2
IFP=I+2
IFPP=NETA+I-3
IFPPP=IFPP+NETA
ISPN=I
ISPP=I-1
ISPPP=IFPP+2
C**** MOMENTUM EQUATION CORRECTION COEFFICIENTS
AM(I+3,1)=-C81+C87*DETA(I-1)
AM(I+3,IFP)=-C74+C88*DETA(I-1)
IF(I-2) 410,410,415
410 AM(I+3,2)=-C73
AM(I+3,3)=-C12
GO TO 420
1
8


415 CALL LIAD(-1,I+3,IFNL,-C73)
CALL LIAD(-1,I+3,IFPP,-C12)
420 CALL LIAD(-1,I+3, IFPPP,-2.*(C3 * XM(4)+ZM(4,I-1)))
LPI=ISPN+MAT1J
DO 450 K=NUL, NSPM1
IF(K) 425,425,430
425 DUM1=C80*DETA(I-1) C76
DUM2=0.
GO TO 435
430 DUM1=CK13(K)*DETA(I-1)-CK17(K)
DUM2=0.
435 AM(I+3,LPI)=DUM1
IF(I-2) 440,440,445
440 AM(I+3,LPI-1) = DUM2
GO TO 450
445 CALL LIAD(K,I-3, ISPP, DUM2)
450 LPI=LPI+MAT2J
C**** ENERGY AND SPECIES EQUATIONS
MPJ=MAT1J+I
DO 535 K=NUL, NSPM1

```
C* *  ALF, F, FP, FPP, FPP ERROR DERIVITIVES ARE DUM1 TO DUM5. DUM6 TO
C* *  DUM8 ARE FLUX DERIVITIVES FOR ALF, FP, FPP.

      IF(K) 455,455,460

C- -  ENERGY EQUATIONS

  455 DUM1=-C82
      DUM2=-C76
      DUM3=-C77
      DUM4=-C76
      DUM6=C82
      DUM7=C77
      DUM8=C78

      GO TO 465

C- -  SPECIES EQUATIONS

  460 DUM1=-(CK21(K)+2.*C56 *CK15(K))
      DUM2=-CK14(K)
      DUM3=-CK19(K)+CK15(K)
      DUM4=-CK20(K)+C10*CK14(K)
      DUM6=CK21(K)
      DUM7=CK19(K)
      DUM8=CK20(K)

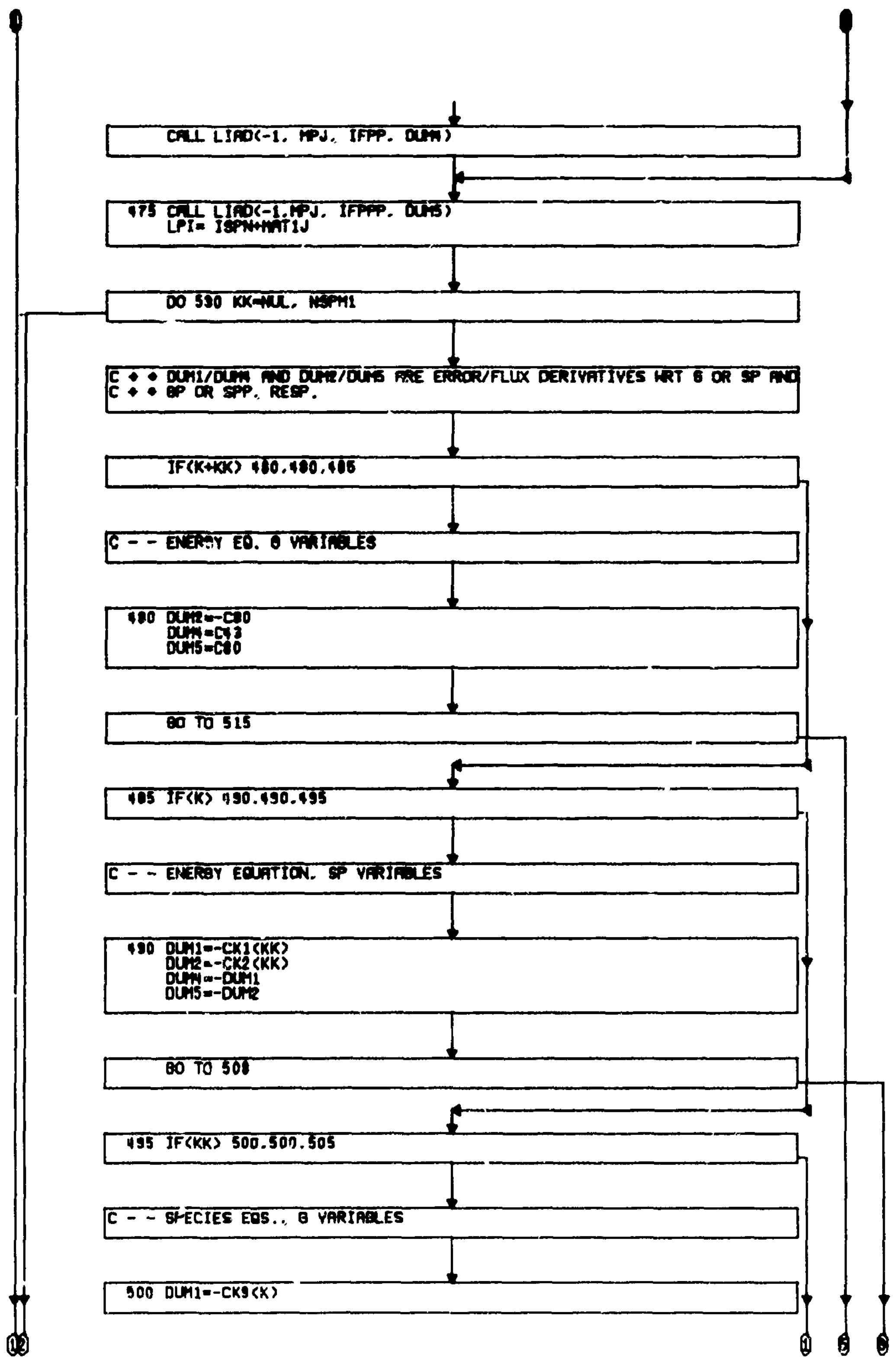
  465 DUM5=C2 *XSP(4,K)-ZSP(4,I-1,K)
      AM(MPJ,1)=DUM1
      AM(MPJ,IFP)= DUM3

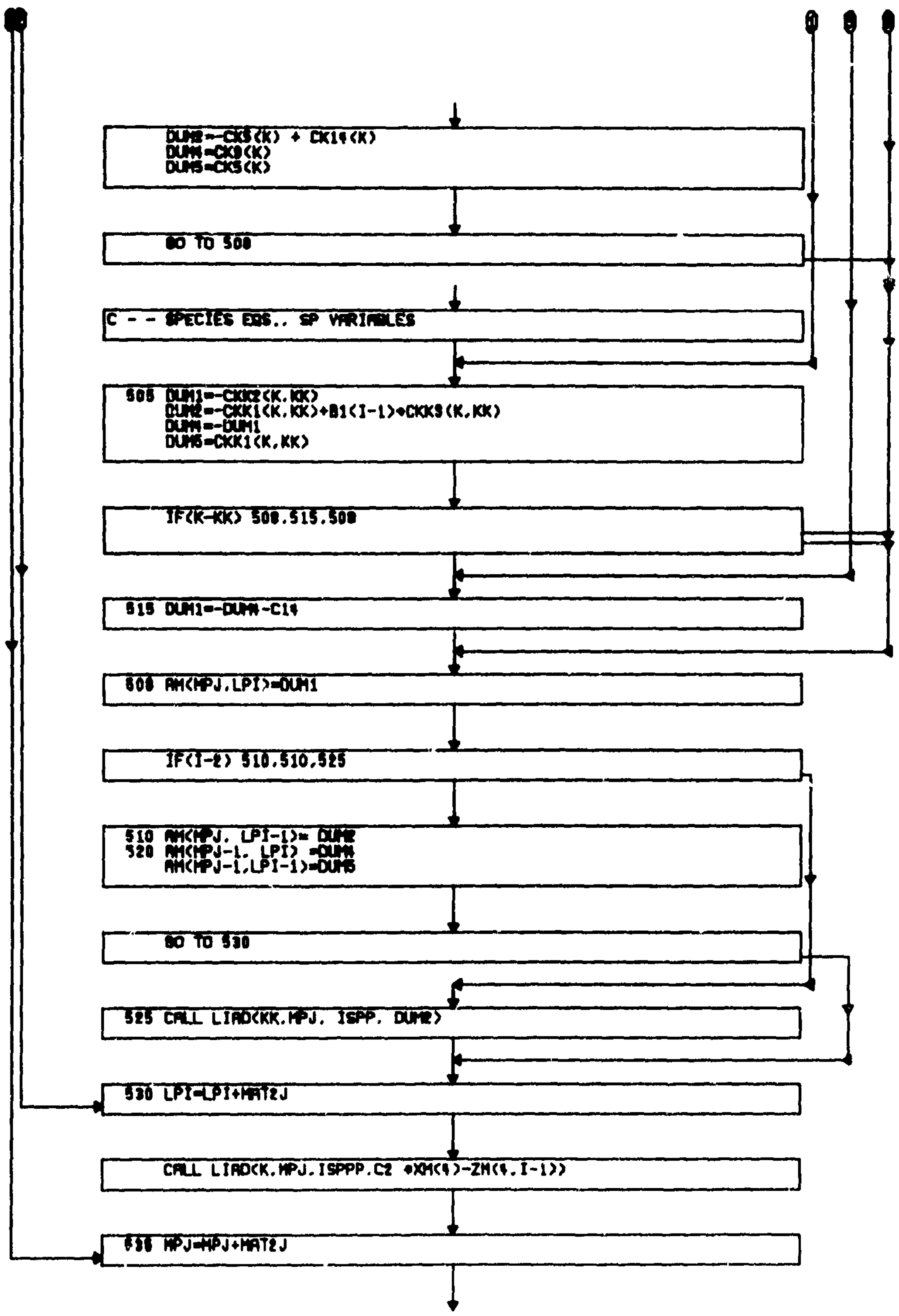
      IF(I-2) 470,470,472

  470 AM(MPJ,2)=DUM2
      AM(MPJ,3)= DUM4
      AM(MPJ-1,1)= DUM6
      AM(MPJ-1, IFP)= DUM7
      AM(MPJ-1,3)= DUM8

      GO TO 475

  472 CALL LIAD(-1,MPJ,IFN,DUM2)
```


CALL LIAD(-1, MPJ, IFPP, DUM4)
475 CALL LIAD(-1,MPJ, IFPPP, DUM5)
LPI= ISPN+MAT1J
DO 530 KK=NUL, NSPM1
C * * DUM1/DUM4 AND DUM2/DUM5 ARE ERROR/FLUX DERIVATIVES WRT G OR SP AND
C * * GP OR SPP, RESP.
IF(K+KK) 480,480,485
C - - ENERGY EQ. G VARIABLES
480 DUM2=-C80
DUM4=C43
DUM5=C80
GO TO 515
485 IF(K) 490,490,495
C - - ENERGY EQUATION, SP VARIABLES
490 DUM1=-CK1(KK)
DUM2=-CK2(KK)
DUM4=-DUM1
DUM5=-DUM2
GO TO 508
495 IF(KK) 500,500,505
C - - SPECIES EQS., G VARIABLES
500 DUM1=-CK9(K)
12
1


DUM2=-CK5(K) + CK14(K)
DUM4=CK9(K)
DUM5=CK5(K)
GO TO 508
C - - SPECIES EQS.. SP VARIABLES
505 DUM1=-CKK2(K,KK)
DUM2=-CKK1(K,KK)+B1(I-1)*CKK3(K,KK)
DUM4=-DUM1
DUM5=CKK1(K,KK)
IF(K-KK) 508,515,508
515 DUM1=-DUM4-C14
508 AM(MPJ,LPI)=DUM1
IF(I-2) 510,510,525
510 AM(MPJ, LPI-1)= DUM2
520 AM(MPJ-1, LPI) =DUM4
AM(MPJ-1,LPI-1)=DUM5
GO TO 530
525 CALL LIAD(KK,MPJ, ISPP, DUM2)
530 LPI=LPI+MAT2J
CALL LIAD(K,MPJ,ISPPP,C2 *XM(4)-ZM(4,I-1))
535 MPJ=MPJ+MAT2J

RETURN

END

13. SUBROUTINE IONLY - B13B

a. Function

Evaluates the coefficients of the I th corrections for the I th nonlinear (conservation) equations, where I is the i th nodal point in the boundary layer. Called by NONCER.

L. Listing

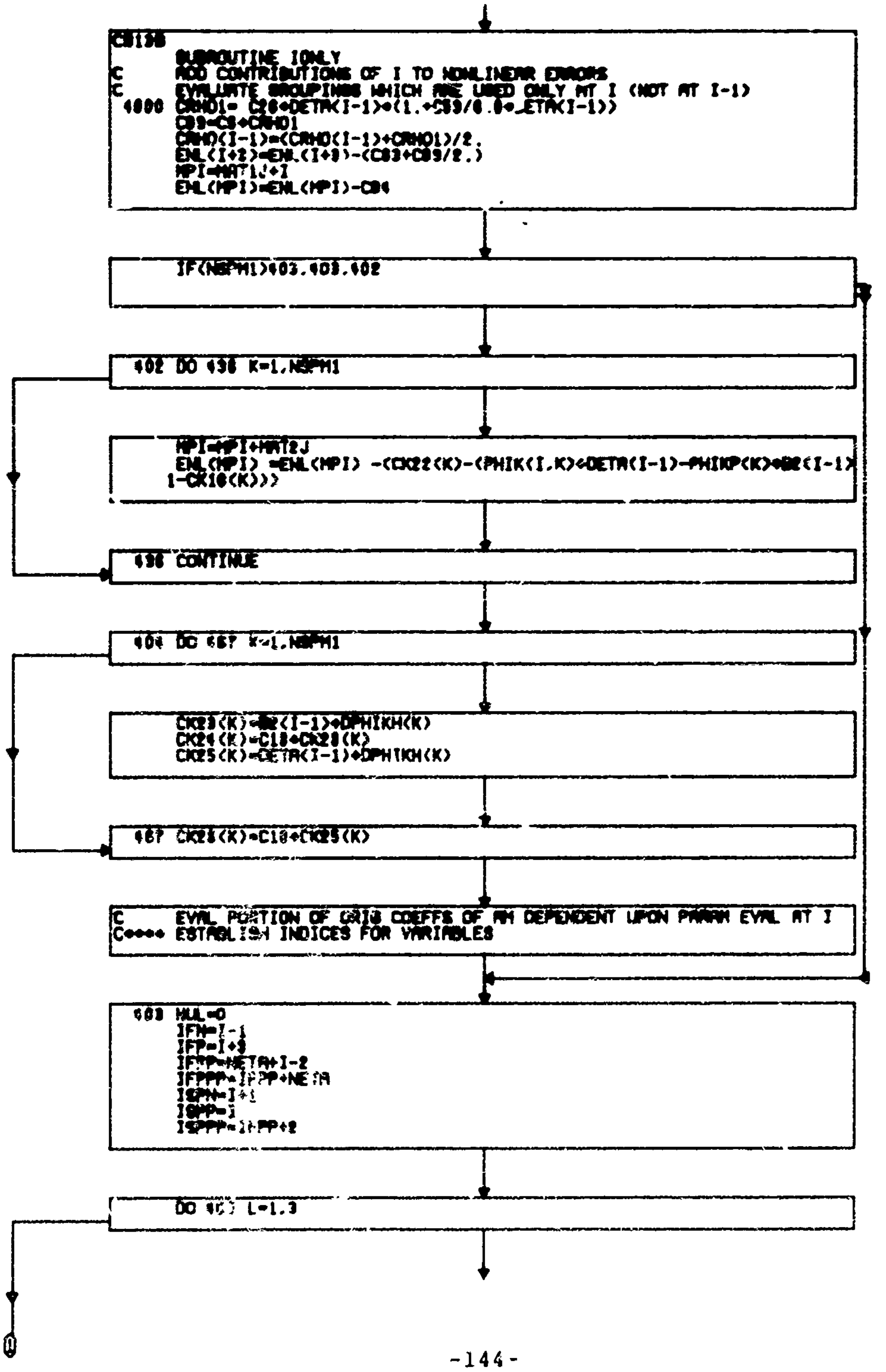
```
      CH13B                                                           B13A 001
            SUBROUTINE IONLY                                          B13A 002
            DIMENSION CK23( 8),CK24( 8),CK25( 8),CK26( 8)             B13A 003*NEW
            COMMON/COECON/              C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B13A   4*NEW
           1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB13A   5*NEW
           232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4B13A   6*NEW
           3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB13A   7*NEW
           465,C66,C67 C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C8B13A   8*NEW
           5,C82,C83,C84,C85,C86,C87,C88                                B13A   9*NEW
            COMMON/COECON/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)   B13A  10*NEW
           1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)     B13A  11*NEW
           2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)  B13A  12*NEW
           3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9) B13A  13*NEW
           4,CKK3( 8, 8)                                                B13A  14*NEW
            COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),FLA(313),FLEM,GLEM    B13A  15*NEW
           1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)    B13A  16*NEW
           2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)     B13A  17*NEW
           3,FNLEM,GNLEM,SPNLEM( 8),           ENLMM,IFNLM,IGNLM,ISPNLM( 8)  B13A  18*NEW
           4,MENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)             B13A  19*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)     B13A  20*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                             B13A  21*NEW
            COMMON/MISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8B13A  22*NEW
           1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUL,HHUE,HFW,DLX2 B13A  23*NEW
           2,CSM(40),BETAM(40)                                          B13A  24*NEW
            COMMON/INTCOM/ KW(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB13A  25*NEW
           1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NWNL, ITS,KAPPA,CHAR,CASE(15) B13A  26*NEW
           2,R(8),         MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B13A  27*NEW
           3,KAUXO,JTIME,JSPEC,MD(3)                                    B13A  28*NEW
            COMMON/NONCOM/AM(153,153),DVNL(153),TCK,                    B13A  29*NEW
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)         B13A  30*NEW
            COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)  B13A  31*NEW
           1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB13A  32*NEW
           2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B13A  33*NEW
           3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)  B13A  34*NEW
           4,DPHIKK( 8, 8),        DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL  B13A  35*NEW
           5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B13A  36*NEW
           6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)  B13A  37*NEW
            DIMENSION CYM(3),CXM(3),CYSP(3)                                        *-36
      C     AND CONTRIBUTIONS OF I TO NONLINEAR ERRORS                  B13A 038
      C     EVALUATE GROUPINGS WHICH ARE USED ONLY AT I (NOT AT I-1)    B13A 039
       4000 CRHO1= C26*DETA(I-1)*(1.+C53/6.0*DETA(I-1))                 B13A 041
            C89=C6*CRHO1                                                B13A 042
            CRHO(I-1)=(CRHO(I-1)+CRHO1)/2.                              B13A 043
            ENL(I+3)=ENL(I+3)-(C83+C89/2.)
            MPI=MAT1J+I
            ENL(MPI)=ENL(MPI)-C84
            IF(NSPM1)403,403,402                                        B13A 051
        402 DO 436 K=1,NSPM1                                            B13A 052
            MPI=MPI+MAT2J
            ENL(MPI) =ENL(MPI) -(CK22(K)-(PHIK(I,K)*DETA(I-1)-PHIKP(K)*B2(I-1)
           1-CK16(K)))
        436 CONTINUE
        404 DO 467 K=1,NSPM1                                            B13A 057
            CK23(K)=B2(I-1)*DPHIKH(K)                                   B13A 058
            CK24(K)=C13*CK23(K)                                         B13A 059
            CK25(K)=DETA(I-1)*DPHIKH(K)                                 B13A 060
        467 CK26(K)=C10*CK25(K)                                         B13A 061
      C     EVAL PORTION OF ORIG COEFFS OF AM DEPENDENT UPON PARAM EVAL AT I  B13A 062
```

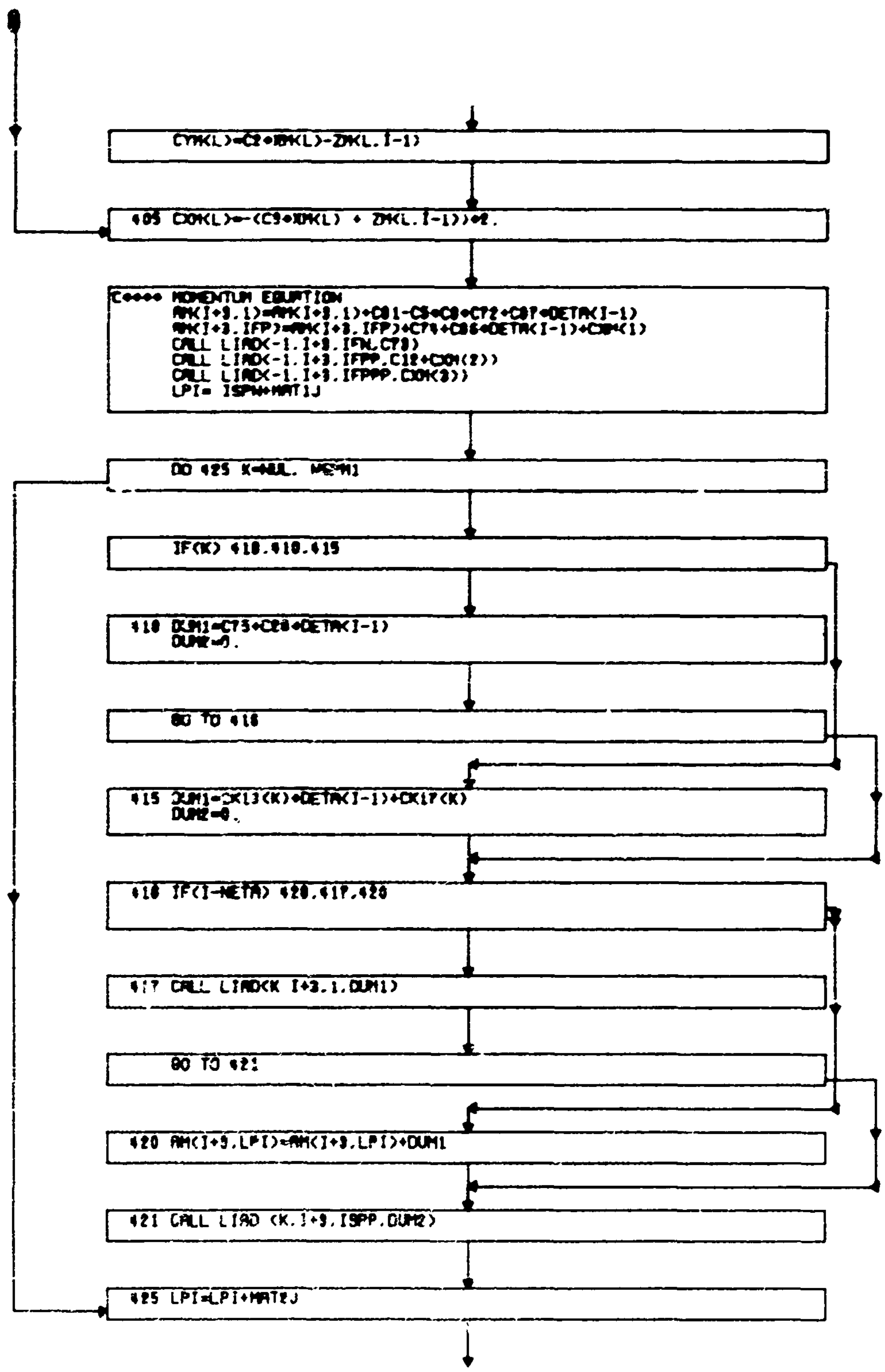
```
C**** ESTABLISH INDICES FOR VARIABLES
  403 NUL=0
      IFN=I-1
      IFP=I+3
      IFPP=NETA+I-2
      IFPPP=IFPP+NETA
      ISPN=I+1
      ISPP=I
      ISPPP=IFPP+2
      DO 405 L=1,3
      CYM(L)=C2*XM(L)-ZM(L,I-1)
  405 CYM(L)=-(C9*XM(L) + ZM(L,I-1))*2.
C**** MOMENTUM EQUATION
      AM(I+3,1)=AM(I+3,1)+C91-C5*C8*C72+C87*DETA(I-1)
      AM(I+3,IFP)=AM(I+3,IFP)+C74+C86*DETA(I-1)+CXM(1)
      CALL LIAD(-1,I+3,IFN,C73)
      CALL LIAD(-1,I+3,IFPP,C12+CXM(2))
      CALL LIAD(-1,I+3,IFPPP,CXM(3))
      LPI= ISPN+MAT1J
      DO 425 K=NUL, NSPM1
      IF(K) 410,410,415
  410 DUM1=C75+C88*DETA(I-1)
      DUM2=0.
      GO TO 416
  415 DUM1=CK13(K)*DETA(I-1)+CK17(K)
      DUM2=0.
  416 IF(I-NETA) 420,417,420
  417 CALL LIAD(K,I+3,1,DUM1)
      GO TO 421
  420 AM(I+3,LPI)=AM(I+3,LPI)+DUM1
  421 CALL LIAD (K,I+3,ISPP,DUM2)
  425 LPI=LPI+MAT2J
C**** ENERGY AND SPECIES EQUATIONS
      MPJ=MAT1J+I
      DO 490 K=NUL, NSPM1
      DO 428 L=1,3
  428 CYSP(L)=C2*XSP(L,K)-ZSP(L,I-1,K)
C * * ALF, F, FP, FPP, FPPP ERROR DERIVITIVES ARE DUM1 TO DUM5.
      IF(K) 430,430,435
C - - ENERGY EQ.
  430 DUM1=C82
      DUM2=C76
      DUM3=C77+CYSP(1)
      DUM4=C78+CYSP(2)
      GO TO 440
C - - SPECIES EQS.
  435 DUM1= CK21(K) +C56 *(CK26(K)-2. *CK24(K))
      DUM2=CK18(K)
      DUM3=CK19(K) + CK24(K)-CK26(K)+CYSP(1)
      DUM4=C10*(CK5(K)+CK23(K)) + CYSP(2)
  440 DUM5= CYSP(3)
      AM(MPJ,1)= AM(MPJ,1) + DUM1
      AM(MPJ, IFP)= AM(MPJ, IFP) + DUM3
      CALL LIAD(-1, MPJ, IFN,DUM2)
      CALL LIAD(-1, MPJ, IFPP, DUM4)
      CALL LIAD(-1, MPJ, IFPPP, DUM5)
      LPI= ISPN+MAT1J
      DO 485 KK=NUL,NSPM1
C * * DUM1 AND DUM2 ARE ERROR DERIVITIVES WRT G OR SP AND GP OR SPP
      IF(K+KK) 445,445,450
```

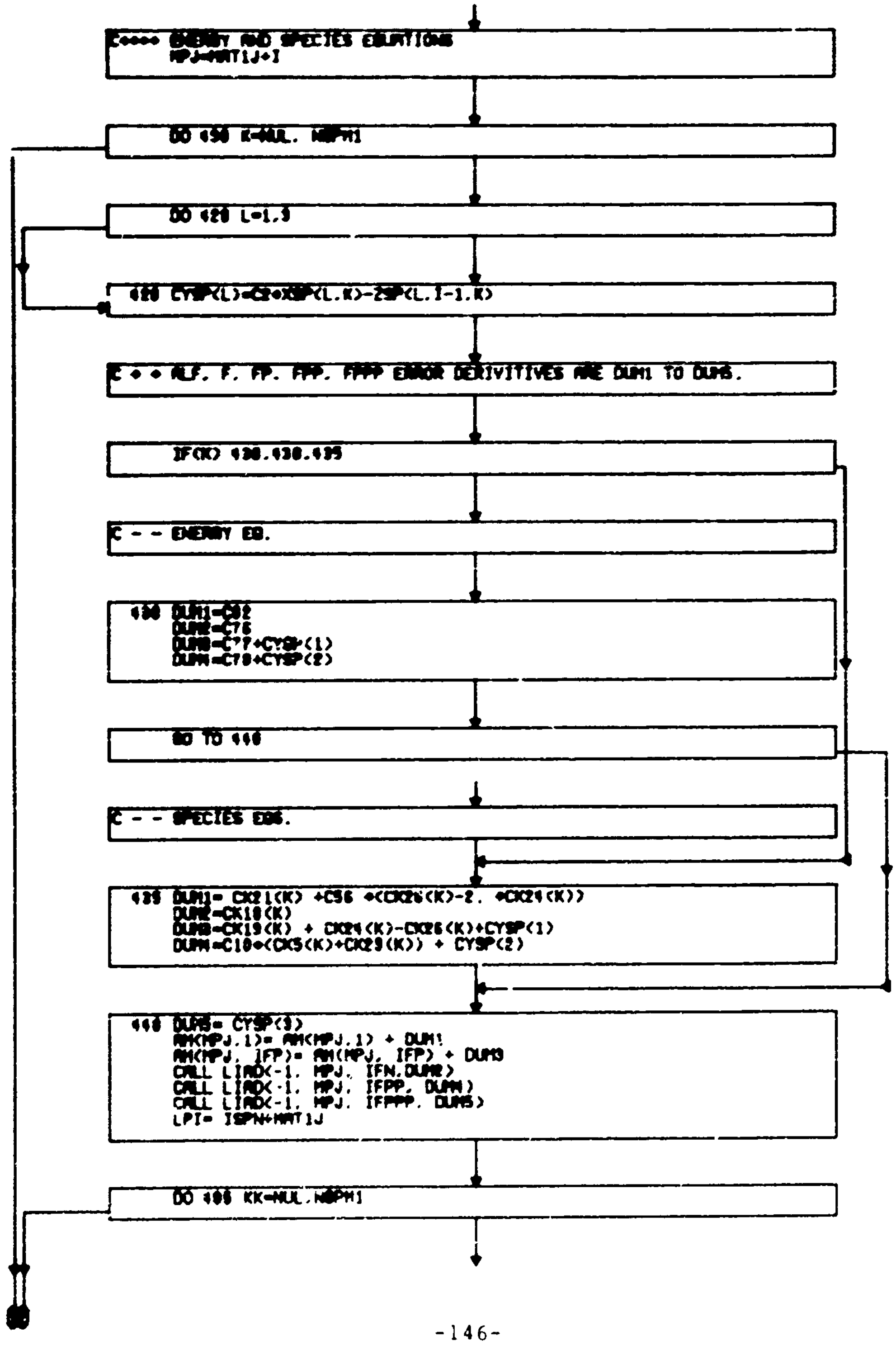
```
C - - ENERGY EQ., G VARIABLES
  445 DUM1=C43
      DUM2=C80
      GO TO 475
  450 IF(K) 455,455,460
C - - ENERGY EQ., SP VARIABLES
  455 DUM1=CK1(KK)
      DUM2=CK2(KK)
      GO TO 480
  460 IF(KK) 465,465,470
C - - SPECIES EQS., G VARIABLES
  465 DUM1= CK9(K)-CK25(K)
      DUM2=CK5(K)+CK23(K)
      GO TO 480
C - - SPECIES EQS., SPECIES VARIABLES
  470 DUM1=CKK2(K,KK)-DPHIKK(K,KK)*DETA(I-1)
      DUM2=CKK1(K,KK)+B2(I-1) * DPHIKK(K,KK)
      IF(K-KK) 480,475,480
  475 DUM1=DUM1+CYM(1)+C14
      DUM2=DUM2+CYM(2)
  480 IF(I-NETA) 483,482,483
  482 CALL LIAD(KK,MPJ,1,DUM1)
      GO TO 484
  483 AM(MPJ,LPI)=AM(MPJ,LPI)+DUM1
  484 CALL LIAD(KK,MPJ,ISPP,DUM2)
  485 LPI= LPI+MAT2J
      CALL LIAD(K,MPJ,ISPPP, CYM(3))
  490 MPJ=MPJ+MAT2J
      RETURN
      END
```

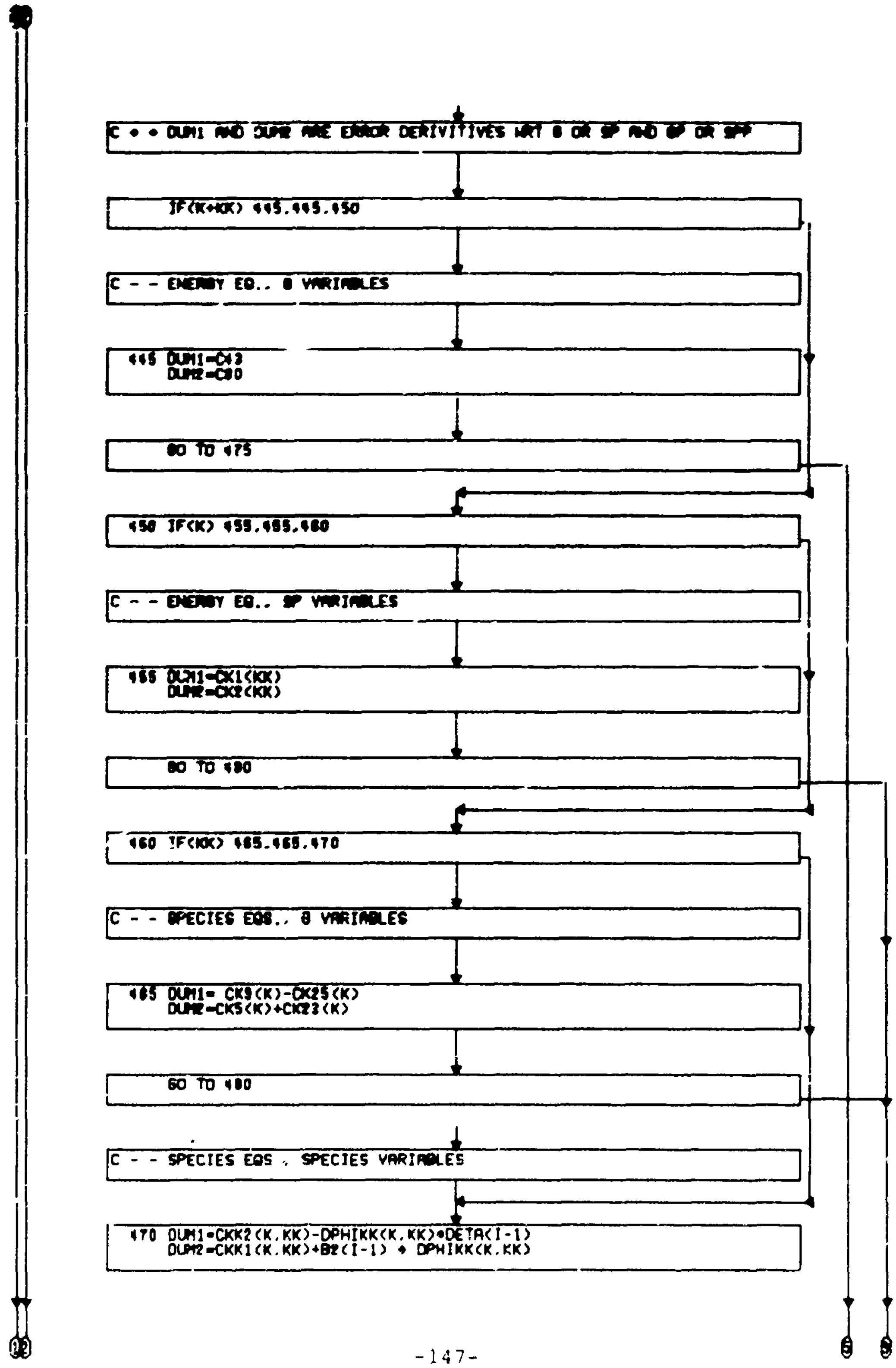

3

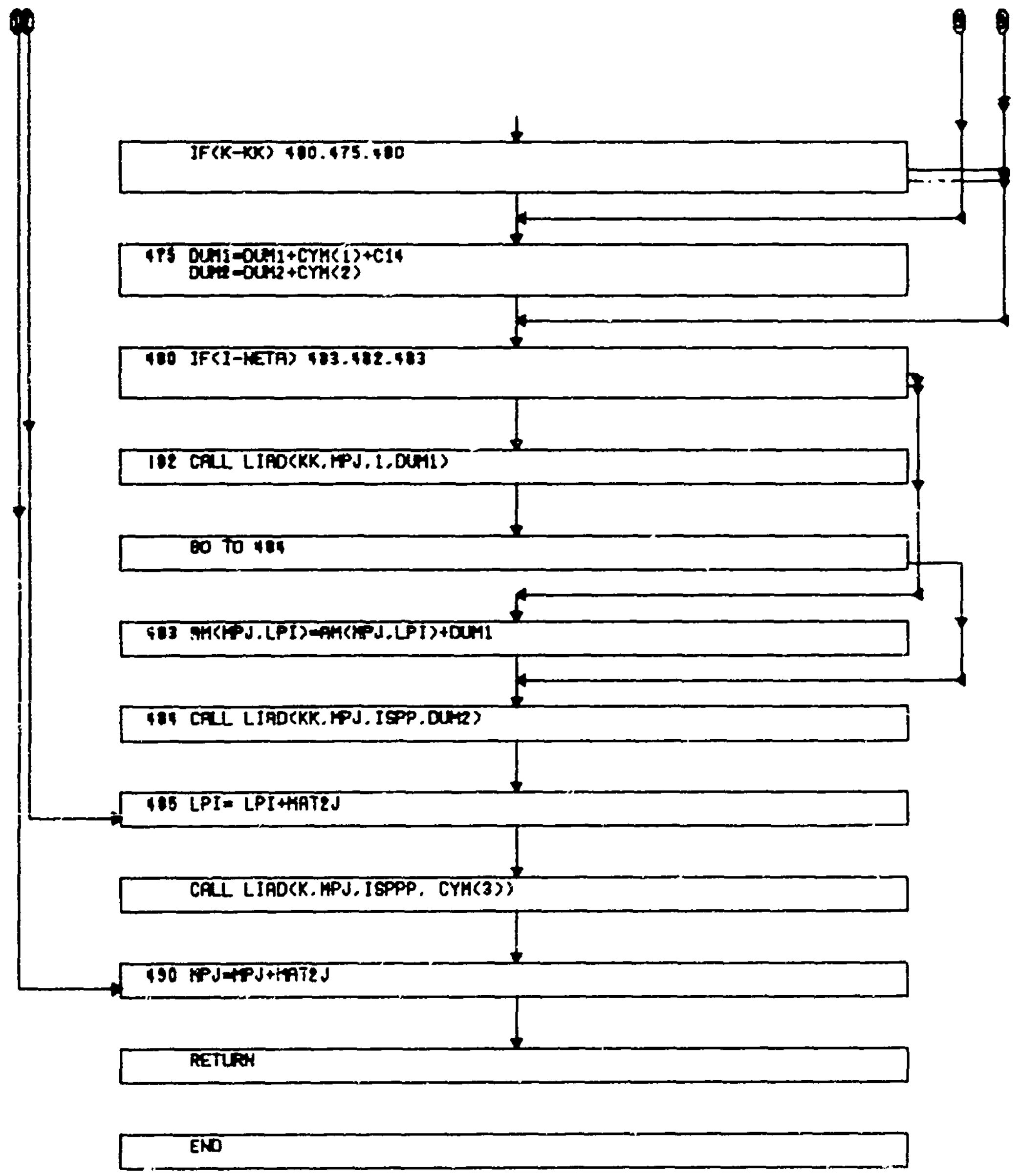
c. Flow Chart


C0130
SUBROUTINE IONLY
C ADD CONTRIBUTIONS OF I TO NONLINEAR ERRORS
C EVALUATE GROUPINGS WHICH ARE USED ONLY AT I (NOT AT I-1)
4000 CRHO1= C26*DETA(I-1)*(1.+C33/6.0*DETA(I-1))
C39=C8*CRHO1
CRHO(I-1)=(CRHO(I-1)+CRHO1)/2.
ENL(I+2)=ENL(I+3)-(C83+C39/2.)
MPI=MAT1J+I
ENL(MPI)=ENL(MPI)-C34
IF(NSPM1)403,403,402
402 DO 436 K=1,NSPM1
MPI=MPI+MAT2J
ENL(MPI) =ENL(MPI) -(CK22(K)-(PHIK(I,K)*DETA(I-1)-PHIKP(K)*B2(I-1)
1-CK10(K)))
436 CONTINUE
404 DO 467 K=1,NSPM1
CK23(K)=B2(I-1)*DPHIKH(K)
CK24(K)=C18*CK23(K)
CK25(K)=DETA(I-1)*DPHIKH(K)
467 CK26(K)=C18*CK25(K)
C EVAL PORTION OF ORIG COEFFS OF AM DEPENDENT UPON PARAM EVAL AT I
C**** ESTABLISH INDICES FOR VARIABLES
403 NUL=0
IFM=I-1
IFP=I+3
IFPP=NETA+I-2
IFPPP=IFPP+NETA
ISPM=I+1
ISPP=I
ISPPP=IFPP+2
DO 405 L=1,3


CYM(L)=C2*XM(L)-ZM(L,I-1)
405 CXM(L)=-(C9*XM(L) + ZM(L,I-1))*2.
C**** MOMENTUM EQUATION
AM(I+3,1)=AM(I+3,1)+C81-C5*C8*C72*C87*DETA(I-1)
AM(I+3,IFP)=AM(I+3,IFP)+C74+C86*DETA(I-1)+CXM(1)
CALL LIAD(-1,I+3,IFN,C73)
CALL LIAD(-1,I+3,IFPP,C12*CXM(2))
CALL LIAD(-1,I+3,IFPPP,CXM(3))
LPI= ISPW+MAT1J
DO 425 K=NUL, MEM1
IF(K) 410,410,415
410 DUM1=C75+C28*DETA(I-1)
DUM2=0.
GO TO 416
415 DUM1=CK13(K)*DETA(I-1)+CK17(K)
DUM2=0.
416 IF(I-NETA) 420,417,420
417 CALL LIAD(K I+3,1,DUM1)
GO TO 421
420 AM(I+3,LPI)=AM(I+3,LPI)+DUM1
421 CALL LIAD (K,I+3,ISPP,DUM2)
425 LPI=LPI+MAT2J


C**** ENERGY AND SPECIES EQUATIONS
MPJ=MAT1J+I
DO 450 K=NUL, NSPM1
DO 420 L=1,3
420 CYSP(L)=C2*XSP(L,K)-ZSP(L,I-1,K)
C * * ALF, F, FP, FPP, FPPP ERROR DERIVITIVES ARE DUM1 TO DUM5.
IF(K) 430,430,435
C - - ENERGY EQ.
430 DUM1=C82
DUM2=C76
DUM3=C77+CYSP(1)
DUM4=C78+CYSP(2)
GO TO 440
C - - SPECIES EQS.
435 DUM1= CX21(K) +C56 *(CX26(K)-2. *CX24(K))
DUM2=CK18(K)
DUM3=CK19(K) + CX24(K)-CX26(K)+CYSP(1)
DUM4=C18*(CX5(K)+CX23(K)) + CYSP(2)
440 DUM5= CYSP(3)
AM(MPJ,1)= AM(MPJ,1) + DUM1
AM(MPJ, IFP)= AM(MPJ, IFP) + DUM3
CALL LIAD(-1, MPJ, IFN,DUM2)
CALL LIAD(-1, MPJ, IFPP, DUM4)
CALL LIAD(-1, MPJ, IFPPP, DUM5)
LPI= ISPN+MAT1J
DO 490 KK=NUL,NSPM1

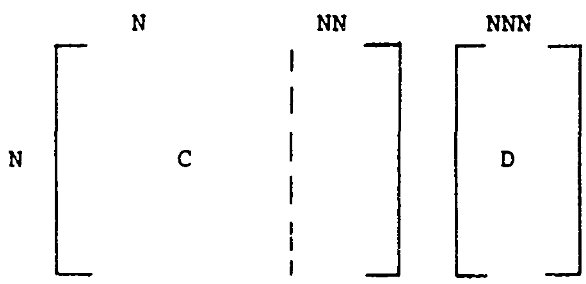

C * * DUM1 AND DUM2 ARE ERROR DERIVITIVES WRT θ OR SP AND θP OR SPP
IF(K+KK) 445,445,450
C - - ENERGY EQ.. θ VARIABLES
445 DUM1=C43
DUM2=C80
GO TO 475
450 IF(K) 455,455,460
C - - ENERGY EQ.. SP VARIABLES
455 DUM1=CK1(KK)
DUM2=CK2(KK)
GO TO 480
460 IF(KK) 465,465,470
C - - SPECIES EQS.. θ VARIABLES
465 DUM1= CK9(K)-CK25(K)
DUM2=CK5(K)+CK23(K)
GO TO 480
C - - SPECIES EQS . SPECIES VARIABLES
470 DUM1=CKK2(K,KK)-DPHIKK(K,KK)*DETA(I-1)
DUM2=CKK1(K,KK)+B2(I-1) + DPHIKK(K,KK)


IF(K-KK) 480.475.480
475 DUM1=DUM1+CYM(1)+C14
DUM2=DUM2+CYM(2)
480 IF(I-NETA) 483.482.483
482 CALL LIAD(KK.MPJ.1.DUM1)
GO TO 484
483 AM(MPJ.LPI)=AM(MPJ.LPI)+DUM1
484 CALL LIAD(KK.MPJ.ISPP.DUM2)
485 LPI= LPI+MAT2J
CALL LIAD(K.MPJ.ISPPP. CYM(3))
490 MPJ=MPJ+MAT2J
RETURN
END

14. SUBROUTINE RERAY (N,C,NN,D,NNN,LS,IS,ND) - B15B

a. Function

Replaces rectangular matrix (C) with N rows and N+NN columns by the product of the inverse of an N by N submatrix and the remaining columns of C. The inverse is also permitted to act on additional columns (Matrix (D) with N rows and NNN columns) from another portion of memory. Also, routine rearranges columns according to arbitrary specification given by LS.



Called by EQUIL, NONCER, RNLCER.

N	=	Number of rows in rectangular matrix (see sketch)
C	=	Elements of rectangular matrix (see sketch)
NN	=	Number of columns in matrix C in excess of those contributing to square matrix (see sketch)
D	=	Elements of matrix of additional columns (see sketch)
NNN	=	Number of additional columns (see sketch)
LS	=	Sequence to which columns of C are rearranged (LS(1)=0 signifies no rearrangement)
IS	=	Flag, yields debug output if RERAY entered with IS=-2, signifies singular matrix if RERAY yields IS less than zero.
ND	=	Dimension on rows of C from calling program

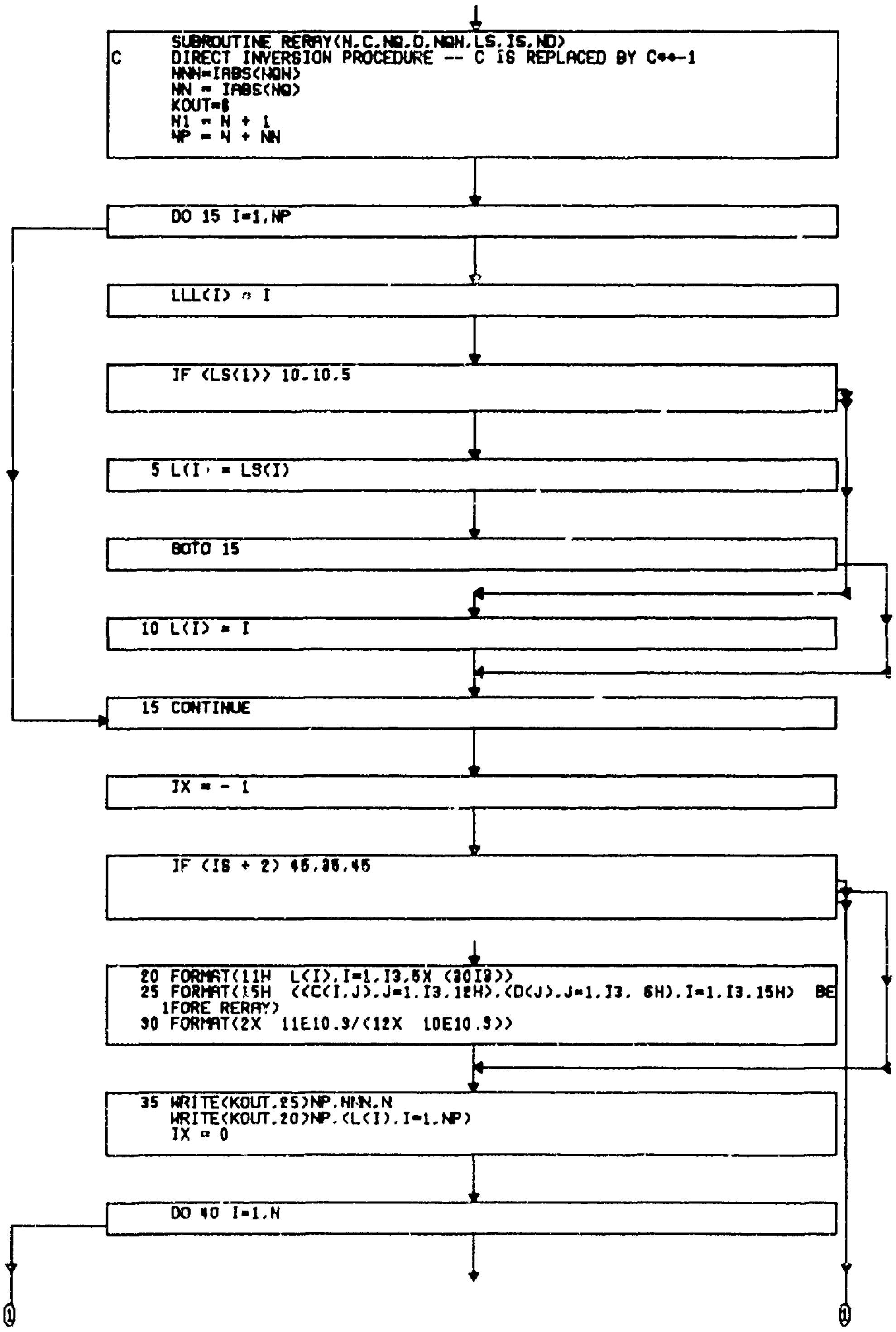
b. Listing

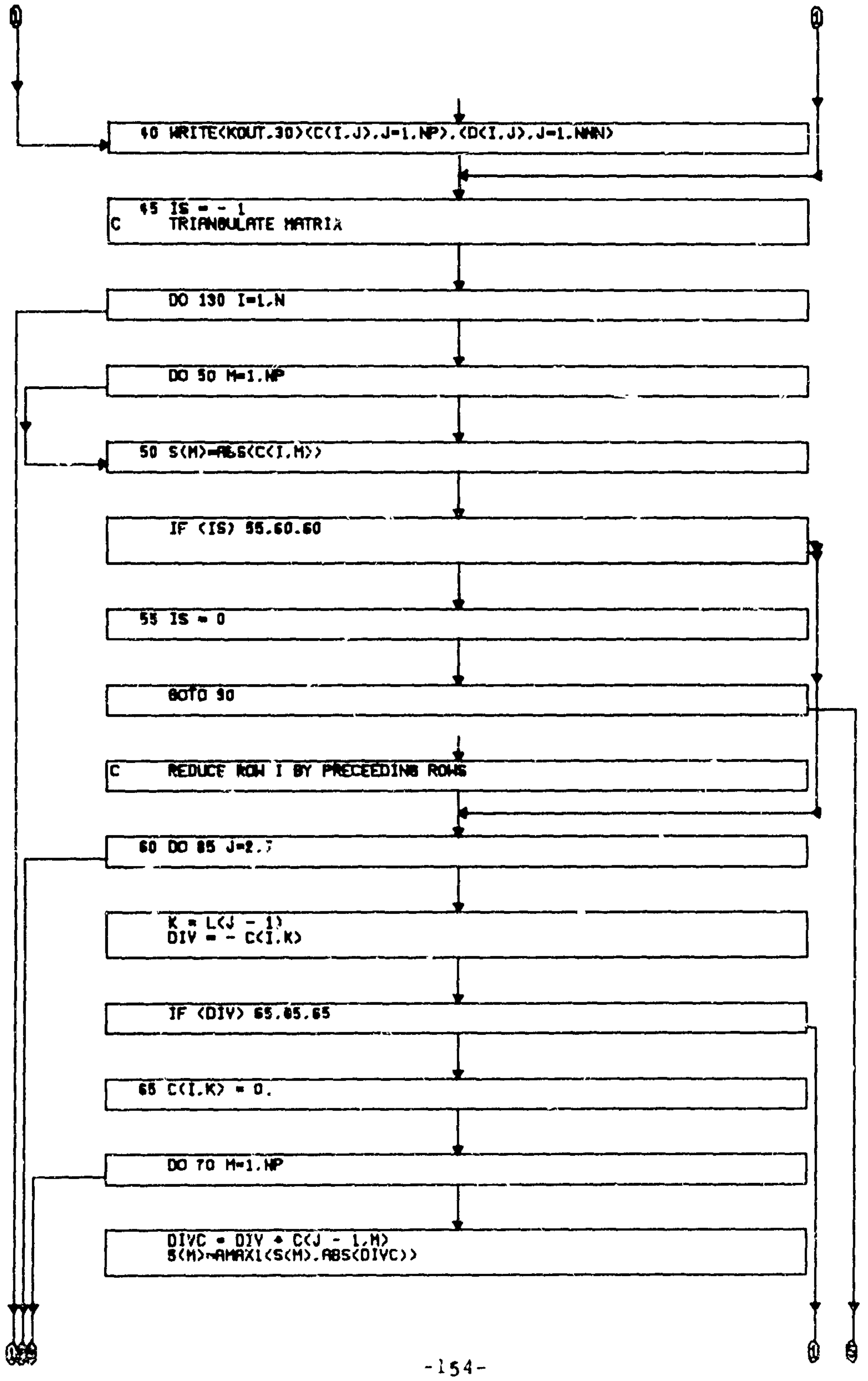
```
      SUBROUTINE RERAY(N,C,NQ,D,NQN,LS,IS,ND)
C     DIRECT INVERSION PROCEDURE -- C IS REPLACED BY C**-1
      DIMENSION D(ND,1),SD(153),C(ND,1),L(153),S(153),LL(153),LLL(153), 815R 003*NEW
     1LS(1)                                                              815R 004*NEW
      NNN=IABS(NQN)                                                          **-2
      NN = IABS(NQ)
      KOUT=6
      N1 = N - 1                                                         RERA0070
      NP = N + NN                                                        RERA0080
      DO 15 I=1,NP                                                       RERA0090
      LLL(I) = I                                                         RERA0110
      IF (LS(1)) 10,10,5                                                 RERA0120
    5 L(I) = LS(I)                                                       RERA0130
      GOTO 15                                                            RERA0140
   10 L(I) = I                                                           RERA0150
   15 CONTINUE                                                           RERA0160
      IX = - 1                                                           RERA0170
      IF (IS + 2) 45,35,45                                               RERA0180
   20 FORMAT(11H  L(I),I=1,I3,5X (30I3))                                 RERA0190
   25 FORMAT(15H  ((C(I,J),J=1,I3,12H),(D(J),J=1,I3, 6H),I=1,I3,15H)  BERERA0200
     1FORE RERAY)                                                        RERA0210
   30 FORMAT(2X  11E10.3/(12X  10E10.3))                                 RERA0220
   35 WRITE(KOUT,25)NP,NNN,N                                             RERA0230
      WRITE(KOUT,20)NP,(L(I),I=1,NP)                                     RERA0240
      IX = 0                                                             RERA0250
      DO 40 I=1,N                                                        RERA0260
   40 WRITE(KOUT,30)(C(I,J),J=1,NP),(D(I,J),J=1,NNN)                     RERA0270
   45 IS = - 1                                                           RERA0280
C     TRIANGULATE MATRIX                                                 RERA0290
      DO 130 I=1,N                                                       RERA0300
      DO 50 M=1,NP
   50 S(M)=ABS(C(I,M))
      IF (I3) 55,60,60                                                   RERA0330
   55 IS = 0                                                             RERA0340
      GOTO 90                                                            RERA0350
C     REDUCE ROW I BY PRECEEDING ROWS                                    RERA0360
   60 DO 85 J=2,I                                                        RERA0370
      K = L(J - 1)                                                       RERA0380
      DIV = - C(I,K)                                                     RERA0390
      IF (DIV) 65,85,65                                                  RERA0400
   65 C(I,K) = 0.                                                        RERA0410
      DO 70 M=1,NP                                                       RERA0420
      DIVC = DIV * C(J - 1,M)                                            RERA0430
      S(M)=AMAX1(S(M),ABS(DIVC))
   70 C(I,M) = C(I,M) + DIVC                                             RERA0450
      IF (NNN) 85,85,75                                                  RERA0460
   75 DO 80 M=1,NNN                                                      RERA0470
   80 D(I,M) = D(I,M) + DIV * D(J - 1,M)                                 RERA0480
   85 CONTINUE                                                           RERA0490
C     SEEK MAXIMUM PIVOT                                                 RERA0500
   90 DIV = 0.                                                           RERA0510
      DO 100 JJ=I,N                                                      RERA0520
      M = L(JJ)                                                          RERA0530
      IF (ABS(C(I,M)) - DIV) 100,100,95                                  RERA0540
   95 DIV = ABS(C(I,M))                                                  RERA0550
      K = M                                                              RERA0560
      J = JJ                                                             RERA0570
      IF(ND-20)  100,100,101
```

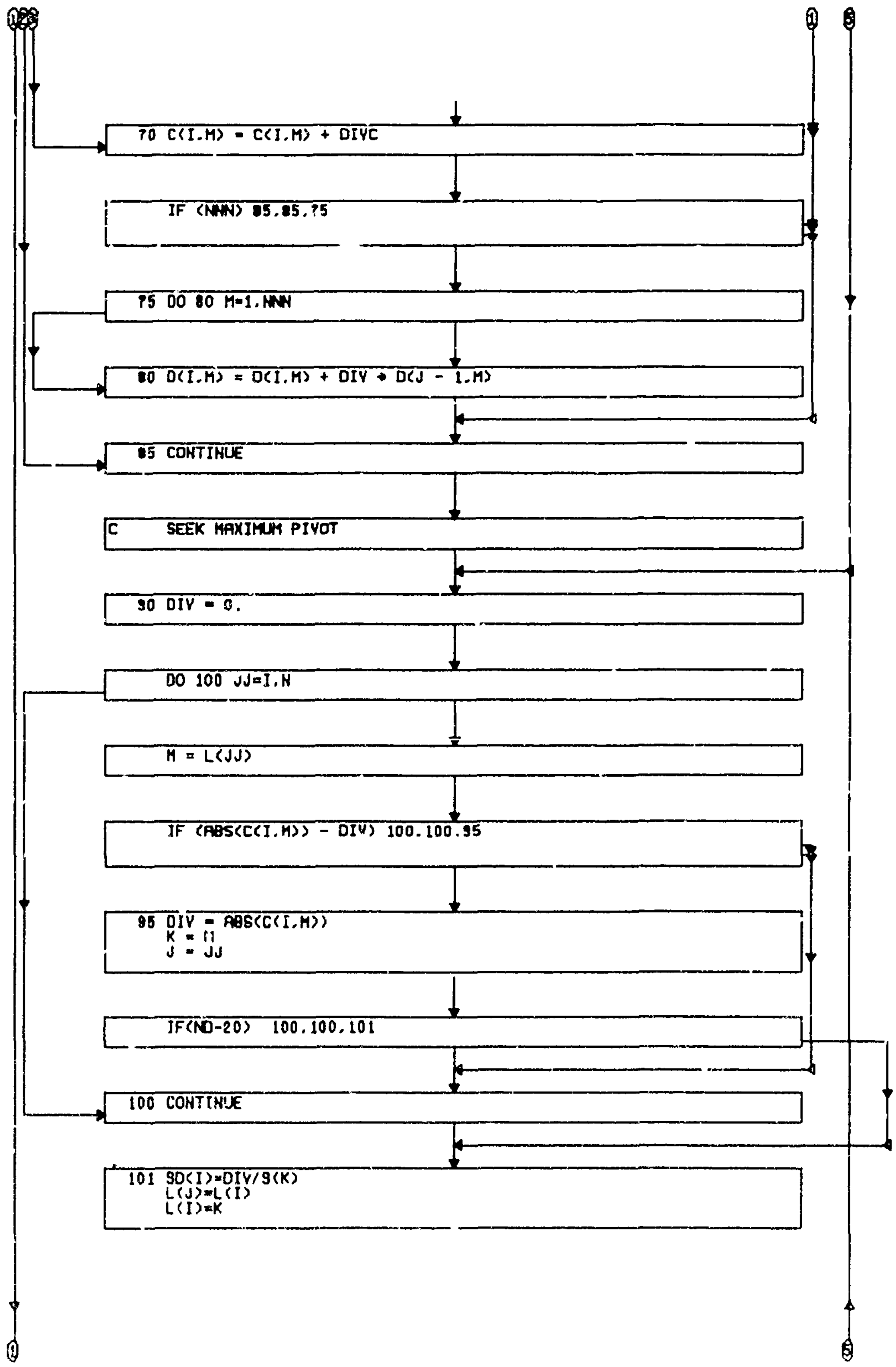
```
  100 CONTINUE                                                          RERA0580
  101 SD(I)=DIV/S(K)
      L(J)=L(I)
      L(I)=K
      IF(SD(I)-1.E-8) 104,104,110
  104 C(I,K)=0.
      IF(SD(I)) 105,105,90
C     SINGULAR MATRIX RETURN
  105 IS=-1
      WRITE(KOUT,135) (II,L(II),SD(II),II=1,I)
      RETURN
  110 DIV = C(I,K)                                                      RERA0670
      C(I,K) = 1.0                                                      RERA0680
      K = LLL(J)                                                        RERA0690
      LLL(J) = LLL(I)                                                   RERA0700
      LLL(I) = K                                                        RERA0710
      LL(K) = I                                                         RERA0720
C     NORMALIZE ROW                                                     RERA0730
      IF (NNN) 125,125,115                                              RERA0740
  115 DO 120 J=1,NNN                                                    RERA0750
  120 D(I,J) = D(I,J) / DIV                                             RERA0760
  125 DO 130 J=1,NP                                                     RERA0770
  130 C(I,J) = C(I,J) / DIV                                             RERA0780
      IF (IX) 145,140,145                                               RERA0790
  135 FORMAT(24H PIVOT ROW/COL/RE3,RATIO 5(I4,1H/I3,1H/E9.2,1H,))       RERA0800
  140 WRITE(KOUT,135)(I,L(I),SD(I),I=1,NP)                              RERA0810
C     DIAGONALIZE MATRIX                                                RERA0820
  145 NM = N - 1                                                        RERA0830
C     INTERCHANGE COLUMNS                                               RERA0960
      DO 225 II=1,NP                                                    RERA0970
      I = II                                                            RERA0980
  180 J = L(I)                                                          RERA0990
      L(I) = I                                                          RERA1000
      IF (J - I) 185,225,185                                            RERA1010
  185 IF (IS) 200,190,200                                               RERA1020
  190 DO 195 M=1,N                                                      RERA1030
      S(M) = C(M,I)                                                     RERA1040
  195 C(M,I) = C(M,J)                                                   RERA1050
      IS = I                                                            RERA1060
      I = J                                                             RERA1070
      GOTO 180                                                          RERA1080
  200 IF (IS - J) 205,215,205                                           RERA1090
  205 DO 210 M=1,N                                                      RERA1100
  210 C(M,I) = C(M,J)                                                   RERA1110
      I = J                                                             RERA1120
      GOTO 180                                                          RERA1130
  215 DO 220 M=1,N                                                      RERA1140
  220 C(M,I) = S(M)                                                     RERA1150
      IS = 0                                                            RERA1160
  225 CONTINUE                                                          RERA1170
      IF(NQN + NQ) 149,149,144
  144 IF(NQN+NQ-NN-NNN) 149,147,149
C*****SOLUTION VECTOR ONLY
  147 K=N
      DO 153 I=1,NM
      K=K-1
      DO 153 IL=K,NM
      DUM=C(K,IL+1)
      IF (NN) 152,152,151
  151 DO 146 M=N1,NP
```

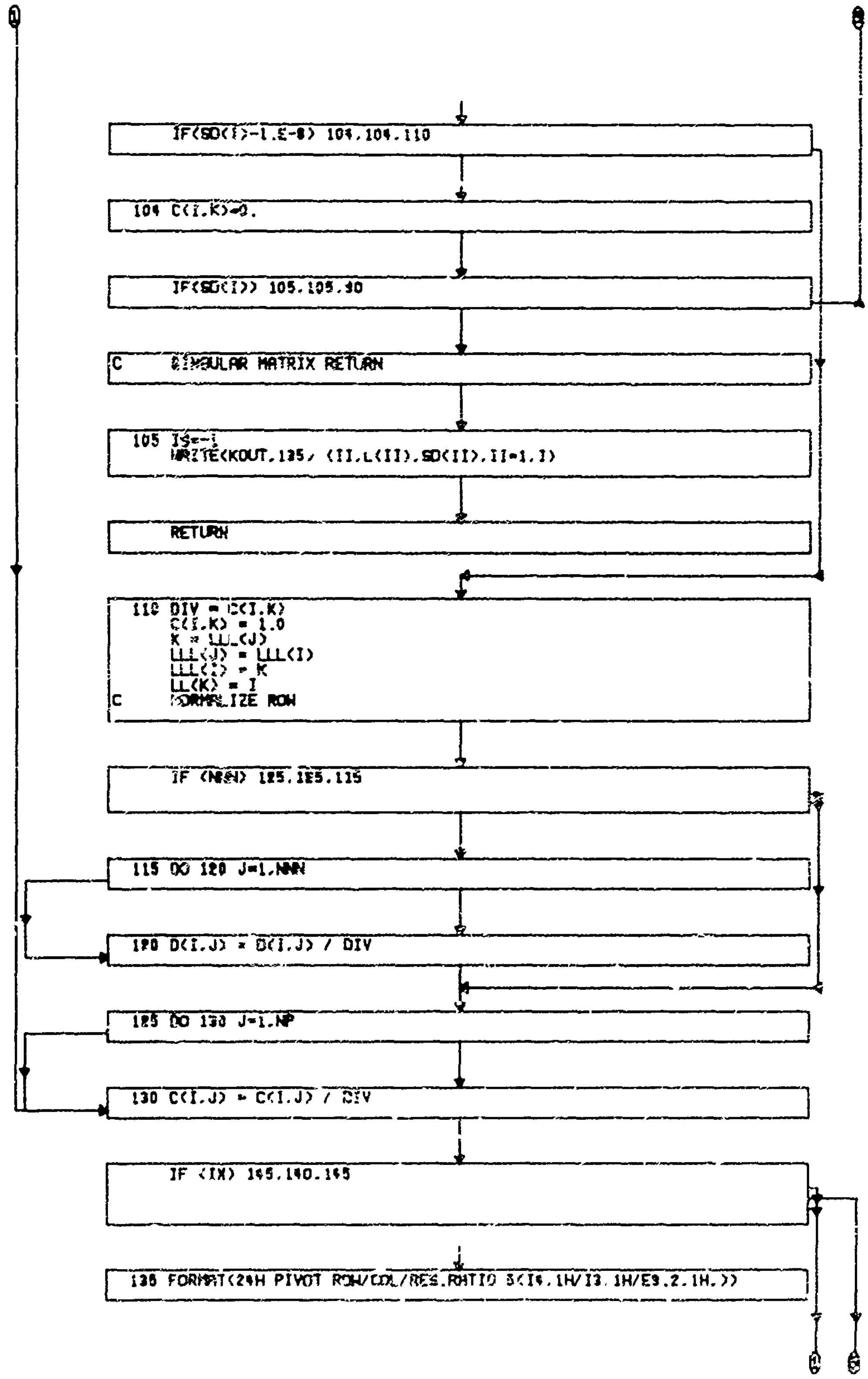
```
      146 C(K,M) = C(K,M) - DUM * C(IL+1,M)
          C(K,1)=C(K,1)-DUM*C(IL+1,1)
          IF (NNN) 153,153,152
      152 DO 148 M=1,NNN
      148 D(K,M)=D(K,M)-DUM*D(IL+1,M)
      153 CONTINUE
          GO TO 176
C*****FULL INVERSION AND SOLUTION VECTOR
      149 DO 175 I=1,NM                                                 RERA0840
          DO 175 J=1,I                                                  RERA0860
          DIV = - C(J,I+1)
          IF (DIV) 150,175,150                                          RERA0880
      150 C(J,I+1) = 0.
          IF (NNN) 165,165,155                                          RERA0900
      155 DO 160 M=1,NNN                                                RERA0910
      160 D(J,M) = D(J,M) + DIV * D(I + 1,M)                            RERA0920
      165 DO 170 M=1,NP                                                 RERA0930
      170 C(J,M) = C(J,M) + DIV * C(I + 1,M)                            RERA0940
      175 CONTINUE                                                      RERA0950
C         INTERCHANGE ROWS                                              RERA1180
      176 DO 320 II=1,N                                                 RERA1190
          I = II                                                        RERA1200
      230 J = LL(I)                                                     RERA1210
          LL(I) = I                                                     RERA1220
          IF (J - I) 235,320,235                                        RERA1230
      235 IF (IS) 265,240,265                                           RERA1240
      240 DO 245 M=1,NP                                                 RERA1250
          S(M) = C(I,M)                                                 RERA1260
      245 C(I,M) = C(J,M)                                               RERA1270
          IF (NNN) 260,260,250                                          RERA1280
      250 DO 255 M=1,NNN                                                RERA1290
          SD(M) = D(I,M)                                                RERA1300
      255 D(I,M) = D(J,M)                                               RERA1310
      260 IS = 1                                                        RERA1320
          I = J                                                         RERA1330
          GOTO 230                                                      RERA1340
      265 IF (IS - J) 270,295,270                                       RERA1350
      270 DO 275 M=1,NP                                                 RERA1360
      275 C(I,M) = C(J,M)                                               RERA1370
          IF (NNN) 290,290,280                                          RERA1380
      280 DO 285 M=1,NNN                                                RERA1390
      285 D(I,M) = D(J,M)                                               RERA1400
      290 I = J                                                         RERA1410
          GOTO 230                                                      RERA1420
      295 DO 300 M=1,NP                                                 RERA1430
      300 C(I,M) = S(M)                                                 RERA1440
          IF (NNN) 315,315,305                                          RERA1450
      305 DO 310 M=1,NNN                                                RERA1460
      310 D(I,M) = SD(M)                                                RERA1470
      315 IS = 0                                                        RERA1480
      320 CONTINUE                                                      RERA1490
          IF (IX) 340,330,340                                           RERA1500
      325 FORMAT(15H  ((C(I,J),J=1,I3,12H),(D(J),J=1,I3, 6H),I=1,I3,15H) AFRERA1510
         1TER RERAY  )                                                  RERA1520
      330 WRITE(KOUT,325)NP,NNN,N                                       RERA1530
          DO 335 I=1,N                                                  RERA1540
      335 WRITE(KOUT,30)(C(I,J),J=1,NP),(D(I,J),J=1,NNN)                RERA1550
      340 RETURN                                                        RERA1560
          END
```

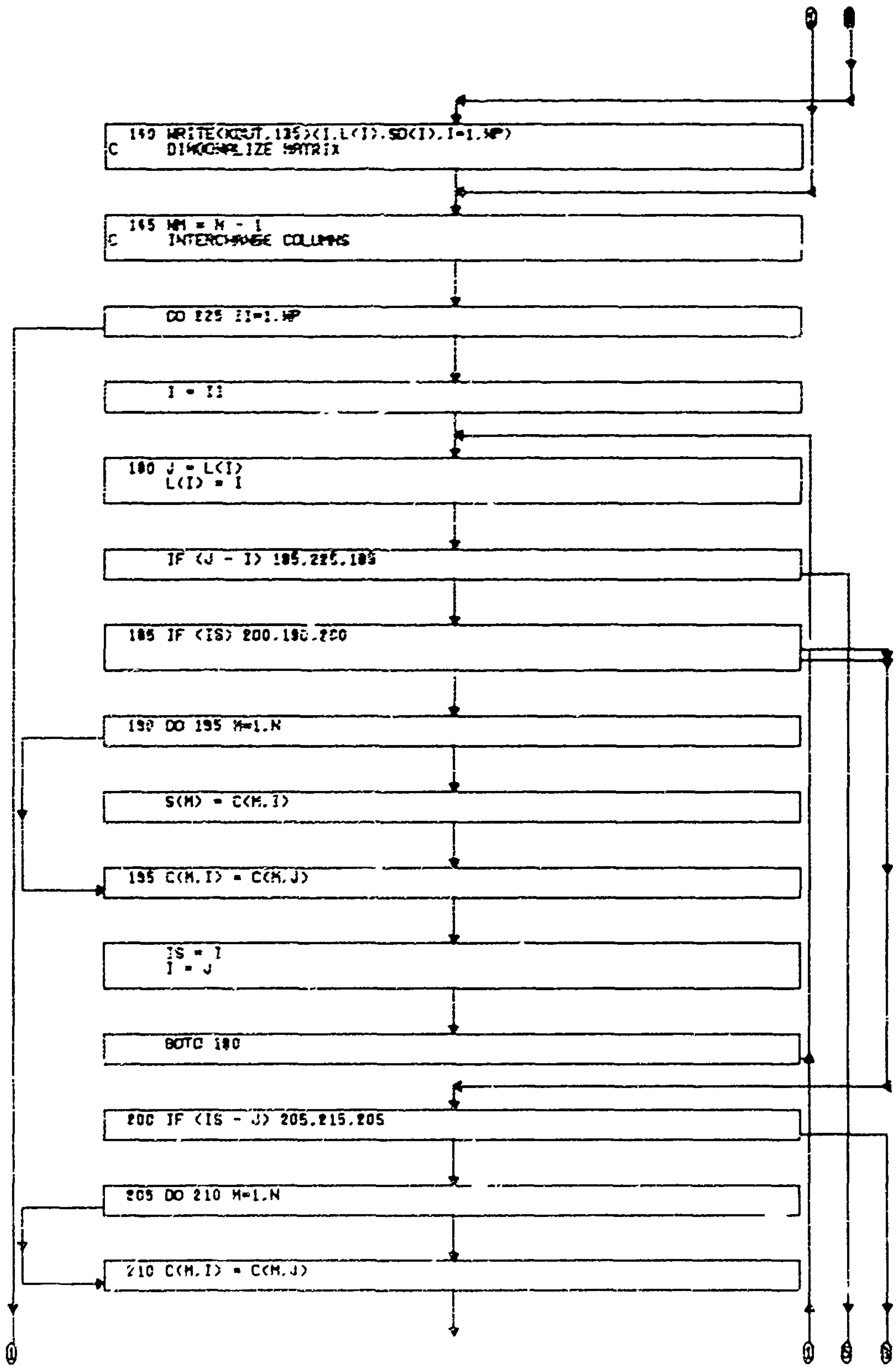
c. Flow Chart

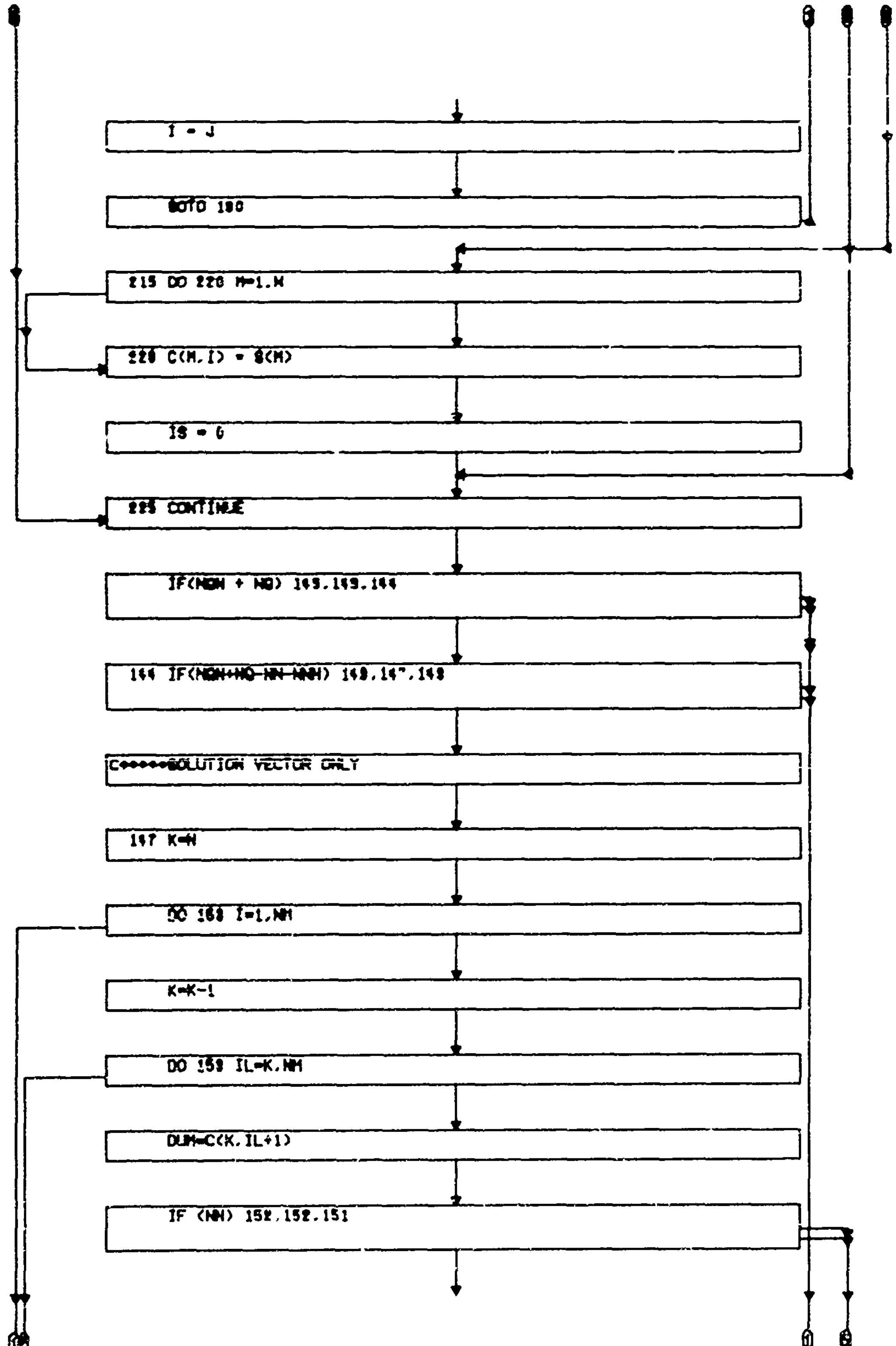

SUBROUTINE RERAY(N,C,NQ,D,NQN,LS,IS,ND)
C DIRECT INVERSION PROCEDURE -- C IS REPLACED BY C**-1
NNN=IABS(NQN)
NN = IABS(NQ)
KOUT=6
N1 = N + 1
NP = N + NN
DO 15 I=1,NP
LLL(I) = I
IF (LS(1)) 10,10,5
5 L(I) = LS(I)
GOTO 15
10 L(I) = I
15 CONTINUE
IX = - 1
IF (IS + 2) 45,35,45
20 FORMAT(11H L(I),I=1,I3,5X (30I3))
25 FORMAT(15H ((C(I,J),J=1,I3,12H),(D(J),J=1,I3, 6H),I=1,I3,15H) BE
1FORE RERAY)
30 FORMAT(2X 11E10.3/(12X 10E10.3))
35 WRITE(KOUT,25)NP,NNN,N
WRITE(KOUT,20)NP,(L(I),I=1,NP)
IX = 0
DO 40 I=1,N
1
1

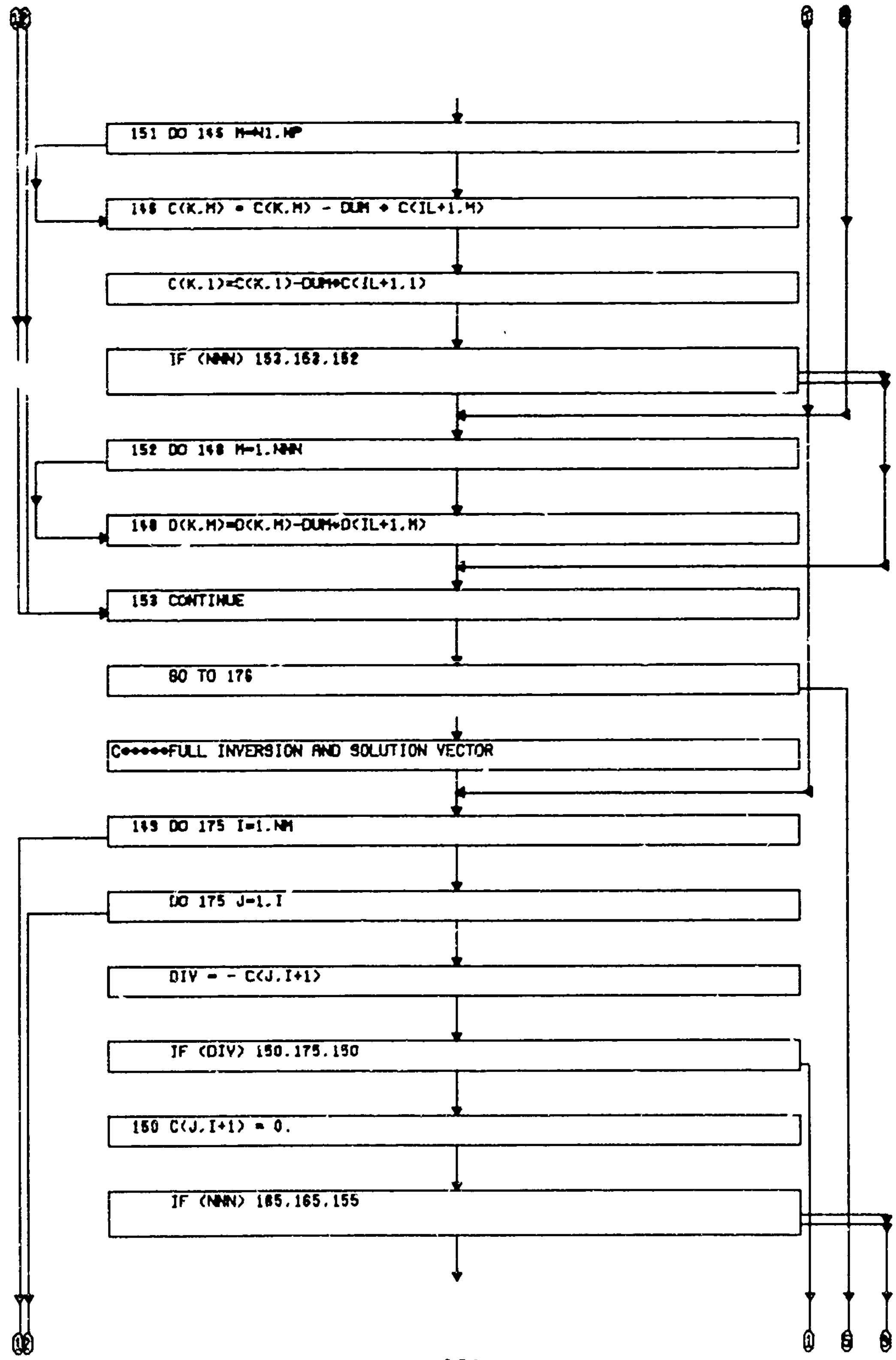

40 WRITE(KOUT,30)(C(I,J),J=1,NP),(D(I,J),J=1,NNN)
45 IS = - 1
C TRIANGULATE MATRIX
DO 130 I=1,N
DO 50 M=1,NP
50 S(M)=ABS(C(I,M))
IF (IS) 55,60,60
55 IS = 0
GOTO 90
C REDUCE ROW I BY PRECEEDING ROWS
60 DO 85 J=2,I
K = L(J - 1)
DIV = - C(I,K)
IF (DIV) 65,85,65
65 C(I,K) = 0.
DO 70 M=1,NP
DIVC = DIV * C(J - 1,M)
S(M)=AMAX1(S(M),ABS(DIVC))

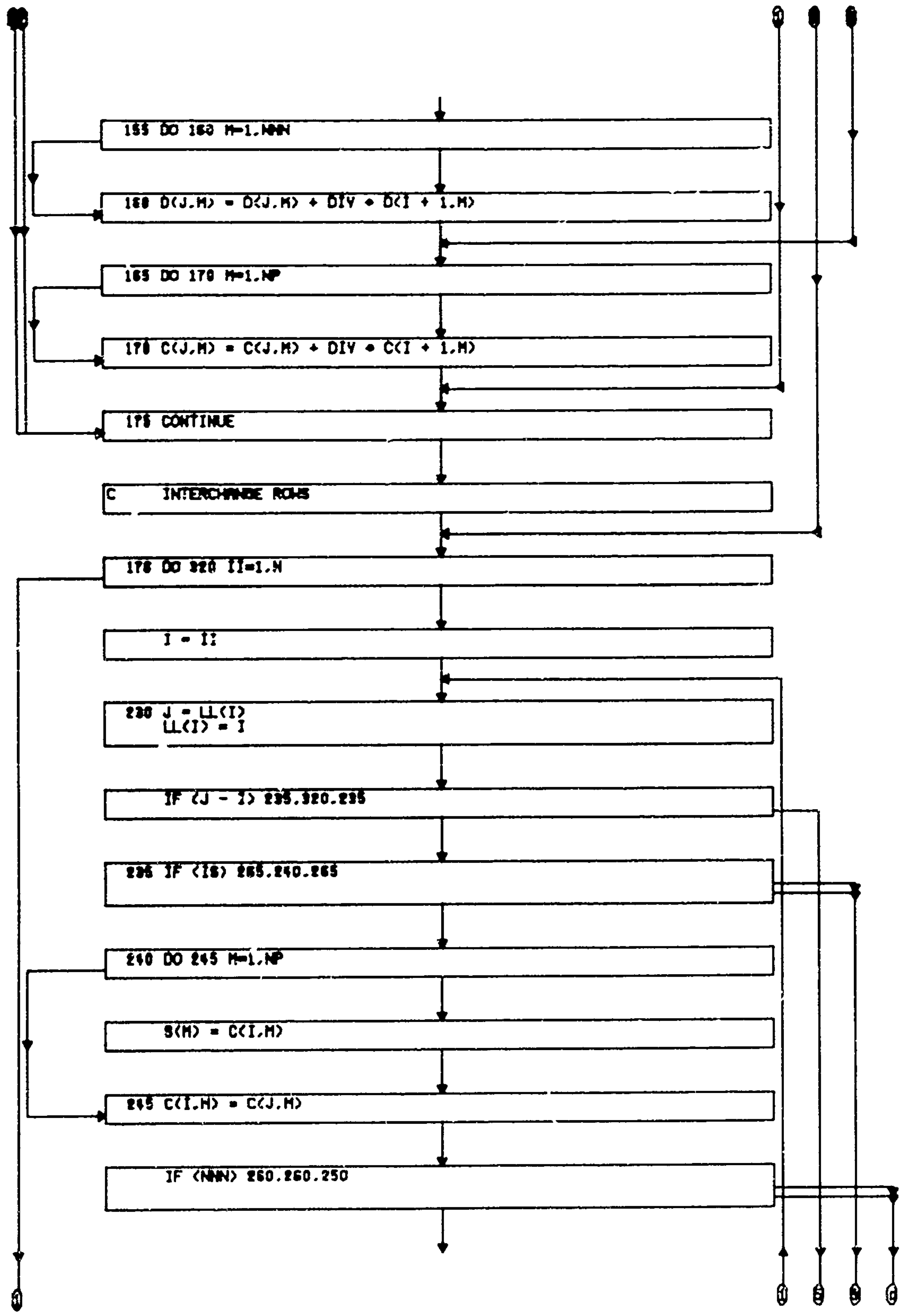

70 C(I,M) = C(I,M) + DIVC
IF (NNN) 85,85,75
75 DO 80 M=1,NNN
80 D(I,M) = D(I,M) + DIV * D(J - 1,M)
85 CONTINUE
C SEEK MAXIMUM PIVOT
90 DIV = 0.
DO 100 JJ=I,N
M = L(JJ)
IF (ABS(C(I,M)) - DIV) 100,100,95
95 DIV = ABS(C(I,M))
K = M
J = JJ
IF(ND-20) 100,100,101
100 CONTINUE
101 SD(I)=DIV/S(K)
L(J)=L(I)
L(I)=K

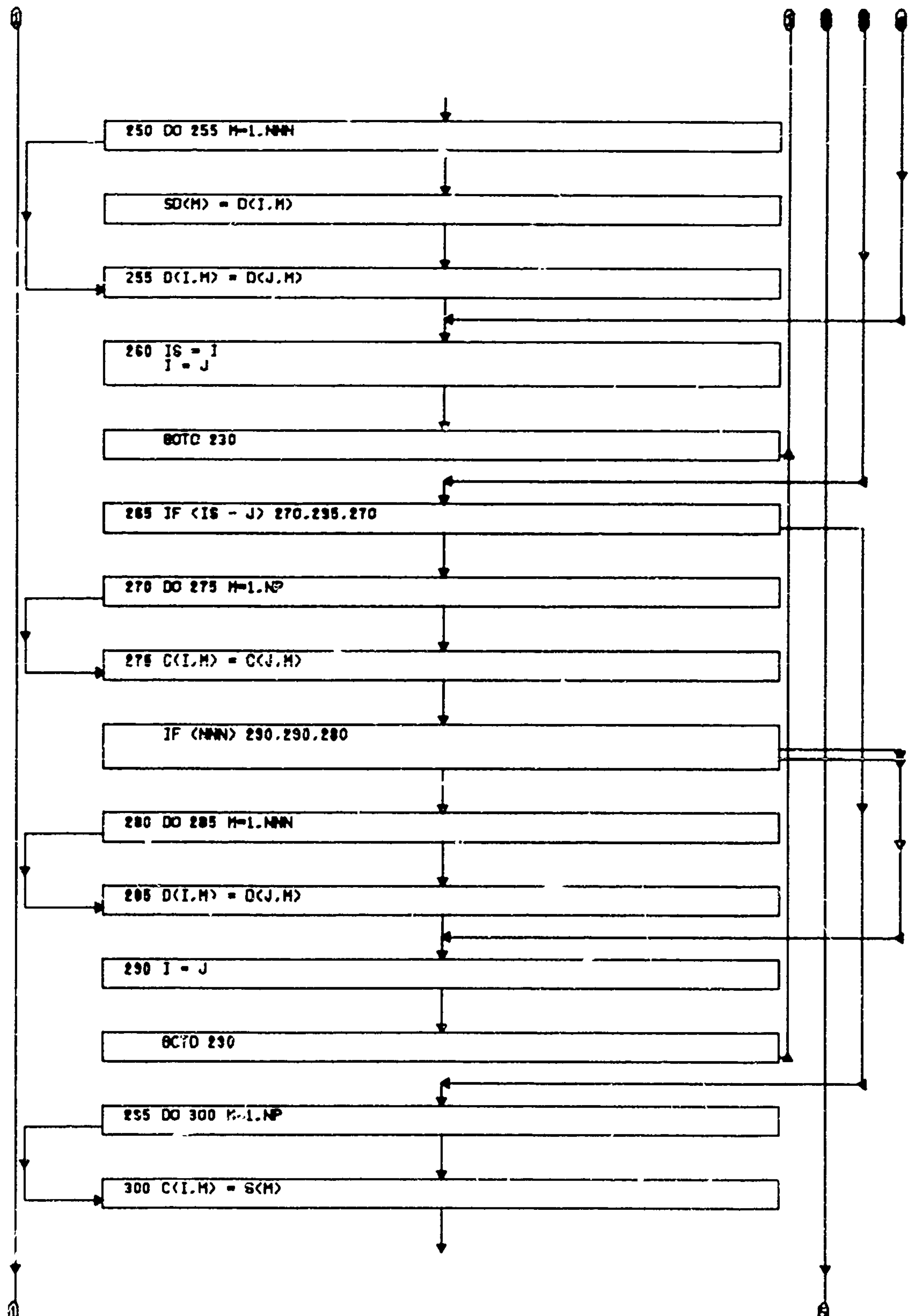

IF(SD(I)-1.E-8) 104,104,110
104 C(I,K)=0.
IF(SD(I)) 105,105,30
C SINGULAR MATRIX RETURN
105 IS=-1
WRITE(KOUT,135) (II,L(II),SD(II),II=1,I)
RETURN
110 DIV = C(I,K)
C(I,K) = 1.0
K = LLL(J)
LLL(J) = LLL(I)
LLL(I) = K
LL(K) = I
C NORMALIZE ROW
IF (NNN) 125,125,115
115 DO 120 J=1,NNN
120 D(I,J) = D(I,J) / DIV
125 DO 130 J=1,NP
130 C(I,J) = C(I,J) / DIV
IF (IX) 145,140,145
135 FORMAT(24H PIVOT ROW/COL/RES.RATIO 5(I4,1H/I3,1H/E9.2,1H,))

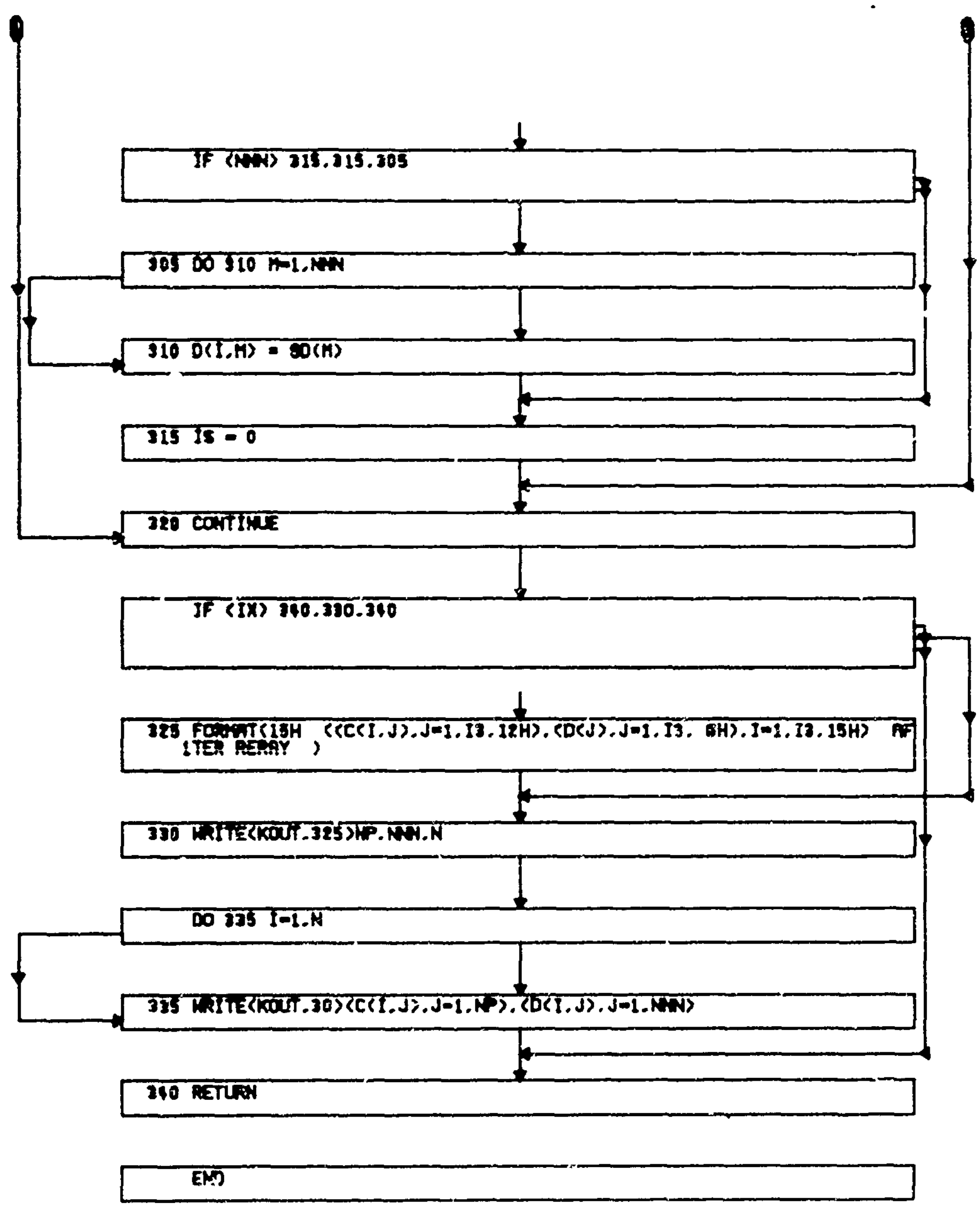

140 WRITE(KOUT,135)(I,L(I),SD(I),I=1,NP)
C DIAGONALIZE MATRIX
145 NM = N - 1
C INTERCHANGE COLUMNS
DO 225 II=1,NP
I = II
180 J = L(I)
L(I) = I
IF (J - I) 185,225,185
185 IF (IS) 200,190,200
190 DO 195 M=1,N
S(M) = C(M,I)
195 C(M,I) = C(M,J)
IS = I
I = J
GOTO 180
200 IF (IS - J) 205,215,205
205 DO 210 M=1,N
210 C(M,I) = C(M,J)


I = J
GOTO 180
215 DO 220 M=1,N
220 C(M,I) = B(M)
IS = 0
225 CONTINUE
IF(NOM + NO) 145,145,144
144 IF(NOM+NO-NN-NNH) 148,147,148
C******SOLUTION VECTOR ONLY
147 K=N
DO 160 I=1,NM
K=K-1
DO 150 IL=K,NM
DUM=C(K,IL+1)
IF (NN) 152,152,151


151 DO 148 M=N1,NP
148 C(K,M) = C(K,M) - DUM * C(IL+1,M)
C(K,1)=C(K,1)-DUM*C(IL+1,1)
IF (NNN) 153,152,152
152 DO 149 M=1,NNN
149 D(K,M)=D(K,M)-DUM*D(IL+1,M)
153 CONTINUE
GO TO 176
C*****FULL INVERSION AND SOLUTION VECTOR
149 DO 175 I=1,NM
DO 175 J=1,I
DIV = - C(J,I+1)
IF (DIV) 150,175,150
150 C(J,I+1) = 0.
IF (NNN) 165,165,155


155 DO 160 M=1,NNN
160 D(J,M) = D(J,M) + DIV * D(I + 1,M)
165 DO 170 M=1,NP
170 C(J,M) = C(J,M) + DIV * C(I + 1,M)
175 CONTINUE
C INTERCHANGE ROWS
178 DO 320 II=1,N
I = II
230 J = LL(I)
LL(I) = I
IF (J - I) 235,320,235
235 IF (IS) 265,240,265
240 DO 245 M=1,NP
S(M) = C(I,M)
245 C(I,M) = C(J,M)
IF (NNN) 260,260,250


250 DO 255 M=1,NNN
SD(M) = D(I,M)
255 D(I,M) = D(J,M)
260 IS = I
I = J
GOTO 230
265 IF (IS - J) 270,295,270
270 DO 275 M=1,NP
275 C(I,M) = C(J,M)
IF (NNN) 290,290,280
280 DO 285 M=1,NNN
285 D(I,M) = D(J,M)
290 I = J
GOTO 230
295 DO 300 M=1,NP
300 C(I,M) = S(M)


IF (NNN) 315,315,305
305 DO 310 M=1,NNN
310 D(I,M) = SD(M)
315 IS = 0
320 CONTINUE
IF (IX) 340,330,340
325 FORMAT(15H ((C(I,J),J=1,I3,12H),(D(J),J=1,I3, 6H),I=1,I3,15H) AF
1TER REARAY)
330 WRITE(KOUT,325)NP,NNN,N
DO 335 I=1,N
335 WRITE(KOUT,30)(C(I,J),J=1,NP),(D(I,J),J=1,NNN)
340 RETURN
END

15. SUBROUTINE SLOPQ (N,X,Y,S,Z) - B16A

a. Function

Based on a sequence of quadratic (3-point) fits of a set of points calculates average slope at each point and integrates the cubic equation thus defined between each pair of points. Called by REFCON.

N = number of points to be considered

X = abscissa at each point

Y = ordinate at each point

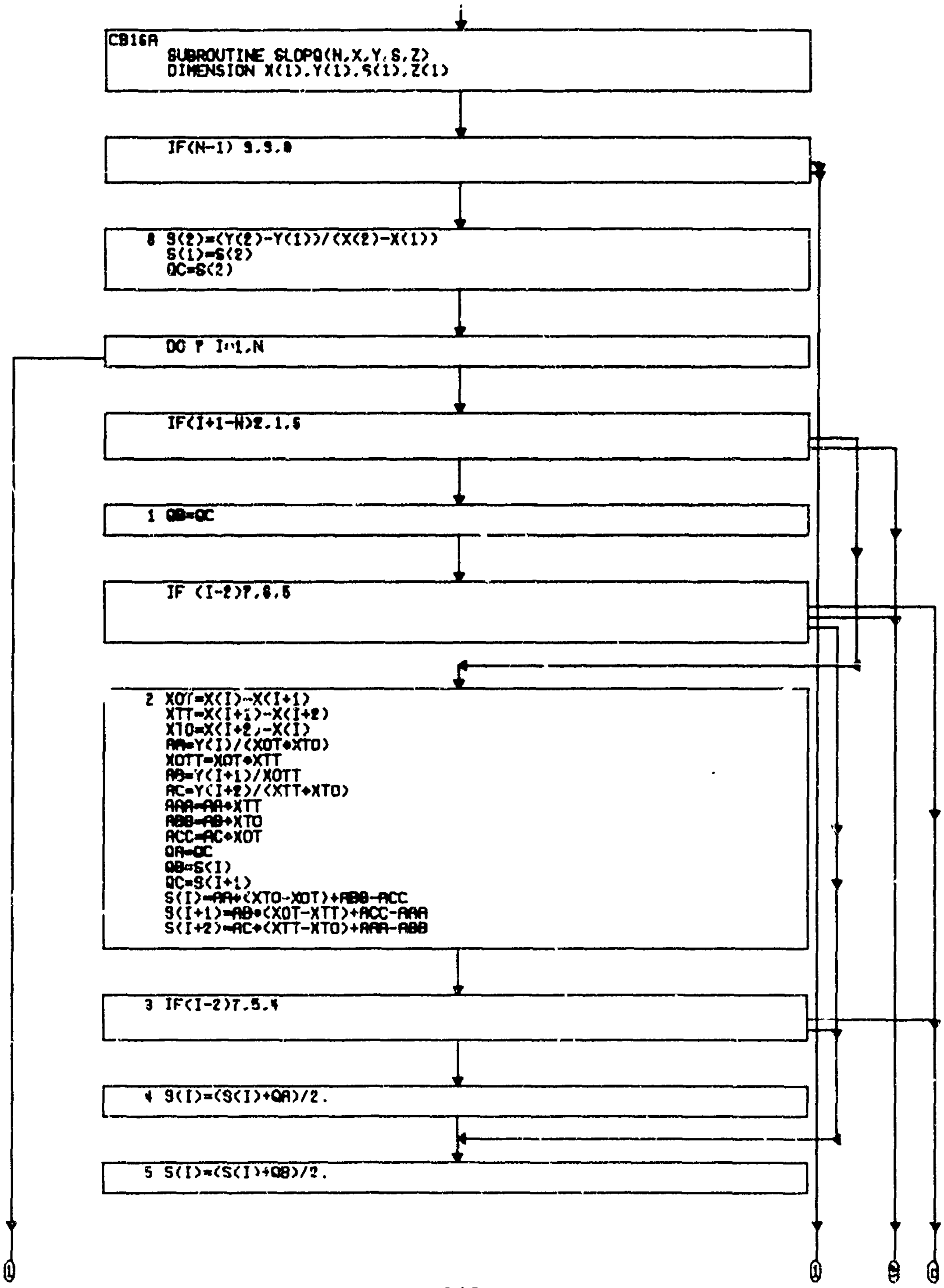
S = derivative at each point

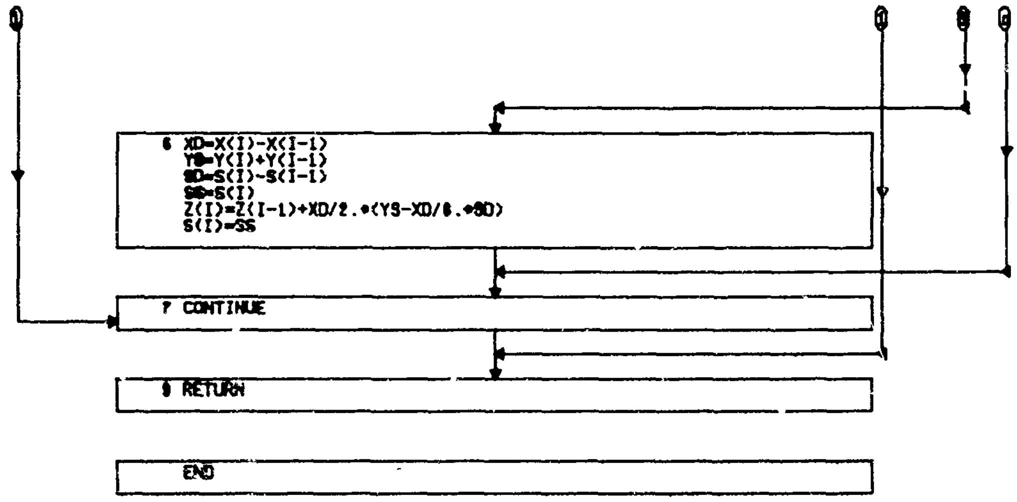
Z = integral up to each point

b. Listing

```
      C816.
            SUBROUTINE SLOPQ(N,X,Y,S,Z)
            DIMENSION X(1),Y(1),S(1),Z(1)
            IF(N-1) 9,9,8
          8 S(2)=(Y(2)-Y(1))/(X(2)-X(1))
            S(1)=S(2)
            QC=S(2)
            DO 7 I=1,N
            IF(I+1-N)2,1,6
          1 QB=QC
            IF (I-2)7,6,5
          2 XOT=X(I)-X(I+1)
            XTT=X(I+1)-X(I+2)
            XTO=X(I+2)-X(I)
            AA=Y(I)/(XOT*XTO)
            XOTT=XOT*XTT
            AB=Y(I+1)/XOTT
            AC=Y(I+2)/(XTT*XTO)
            AAA=AA*XTT
            ABB=AB*XTO
            ACC=AC*XOT
            QA=QC
            QB=S(I)
            QC=S(I+1)
            S(I)=AA*(XTO-XOT)+ABB-ACC
            S(I+1)=AB*(XOT-XTT)+ACC-AAA
            S(I+2)=AC*(XTT-XTO)+AAA-ABB
          3 IF(I-2)7,5,4
          4 S(I)=(S(I)+QA)/2.
          5 S(I)=(S(I)+QB)/2.
          6 XD=X(I)-X(I-1)
            YS=Y(I)+Y(I-1)
            SD=S(I)-S(I-1)
            SS=S(I)
            Z(I)=Z(I-1)+XD/2.*(YS-XD/6.*SD)
            S(I)=SS
          7 CONTINUE
          9 RETURN
            END
```

c. Flow Chart


CB16A
SUBROUTINE SLOPQ(N,X,Y,S,Z)
DIMENSION X(1),Y(1),S(1),Z(1)
IF(N-1) 9,9,8
8 S(2)=(Y(2)-Y(1))/(X(2)-X(1))
S(1)=S(2)
QC=S(2)
DO 7 I=1,N
IF(I+1-N)2,1,6
1 QB=QC
IF (I-2)7,6,5
2 XOT=X(I)-X(I+1)
XTT=X(I+1)-X(I+2)
XTO=X(I+2)-X(I)
AA=Y(I)/(XOT*XTO)
XOTT=XOT*XTT
AB=Y(I+1)/XOTT
AC=Y(I+2)/(XTT*XTO)
AAA=AA*XTT
ABB=AB*XTO
ACC=AC*XOT
QA=QC
QB=S(I)
QC=S(I+1)
S(I)=AA*(XTO-XOT)+ABB-ACC
S(I+1)=AB*(XOT-XTT)+ACC-AAA
S(I+2)=AC*(XTT-XTO)+AAA-ABB
3 IF(I-2)7,5,4
4 S(I)=(S(I)+QA)/2.
5 S(I)=(S(I)+QB)/2.


6 XD=X(I)-X(I-1)
YS=Y(I)+Y(I-1)
SD=S(I)-S(I-1)
SS=S(I)
Z(I)=Z(I-1)+XD/2.*(YS-XD/6.*SD)
S(I)=SS
7 CONTINUE
8 RETURN
END

16. SUBROUTINE ABMAX (N,X,XM,I) - B17A

a. Function

Searches an array for the entry with maximum value. Called by LINCER, NONCER.

N = number of entries in the array

X = coefficients in array under consideration

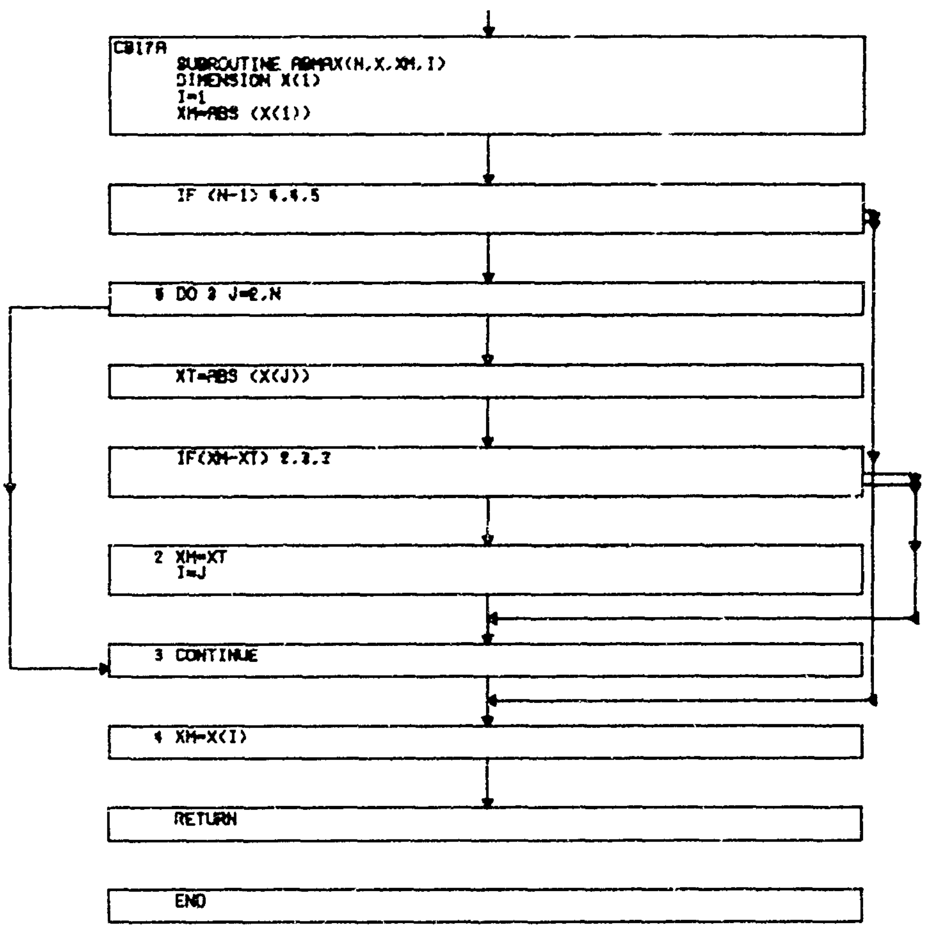
XM = entry with maximum absolute value

I = index on XM.

b. Listing

```
C817A
      SUBROUTINE ABMAX(N,X,XM,I)
      DIMENSION X(1)
      I=1
      XM=ABS (X(1))
      IF (N-1) 4,4,5
    5 DO 3 J=2,N
      XT=ABS (X(J))
      IF(XM-XT) 2,3,3
    2 XM=XT
      I=J
    3 CONTINUE
    4 XM=X(I)
      RETURN
      END
```

c. Flow Chart


C017A
SUBROUTINE ABMAX(N,X,XM,I)
DIMENSION X(1)
I=1
XM=ABS (X(1))
IF (N-1) 4,4,5
5 DO 3 J=2,N
XT=ABS (X(J))
IF(XM-XT) 2,3,3
2 XM=XT
I=J
3 CONTINUE
4 XM=X(I)
RETURN
END

17. SUBROUTINE MATS1 - B18A

a. Function

Performs operations on a column of a matrix B or on a column of errors R (designated E in call list) such as to form A**(-1)*E where A**(-1) is the inverse of the sparse matrix formed from the Taylor series expansions of F(1,I) and their derivatives (in the case of MATS1) and of G(1,I) or SP(1,I,K) and their derivatives (in the case of MATS2), viz.,

Original matrix equation

$$(A + B)V = R$$

multiplying through by A**(-1)

$$(1 + A^{**}(-1)^{*}B)V = A^{**}(-1)^{*}R$$

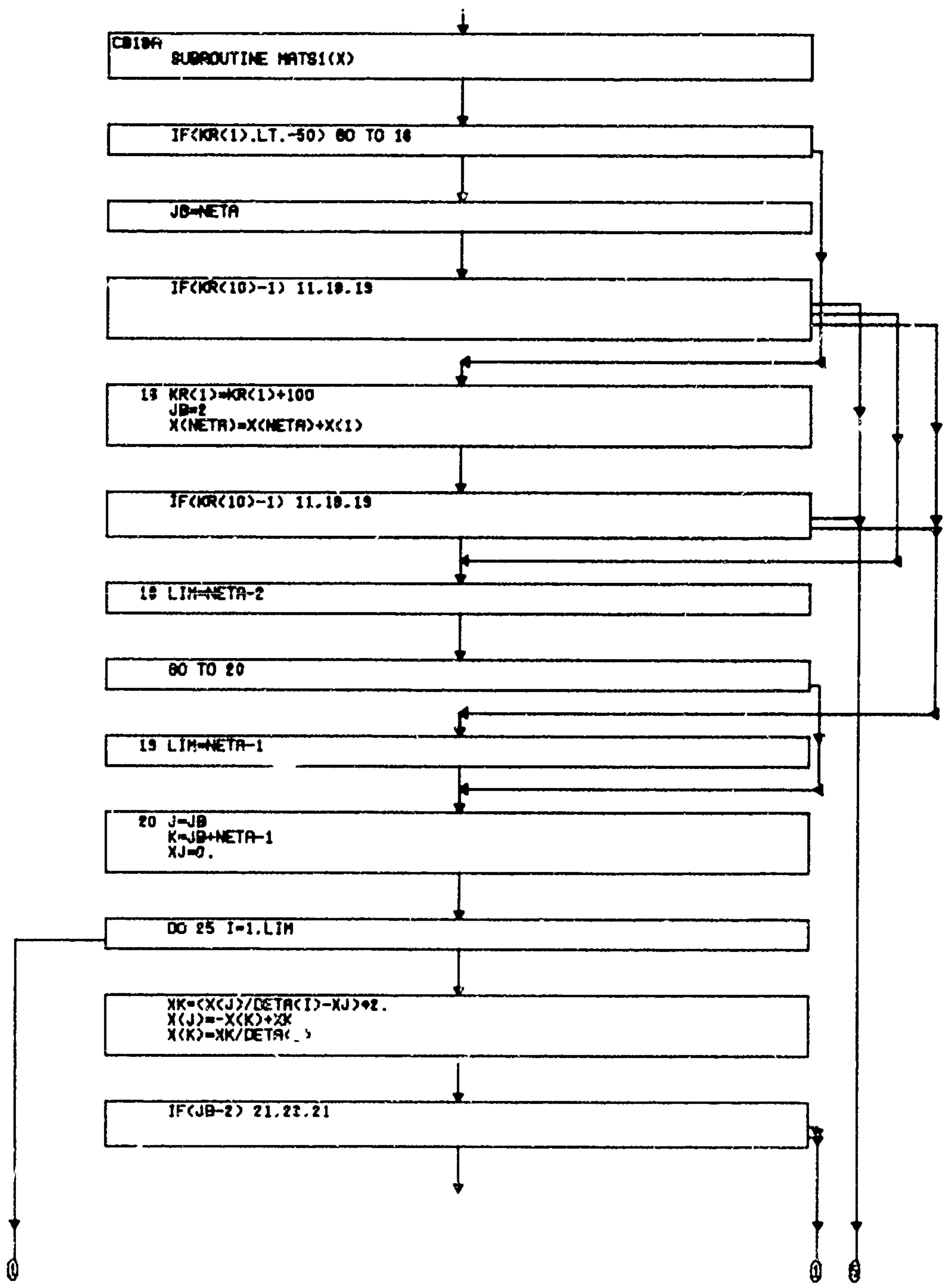
Called by LINCEP, LINMAT.

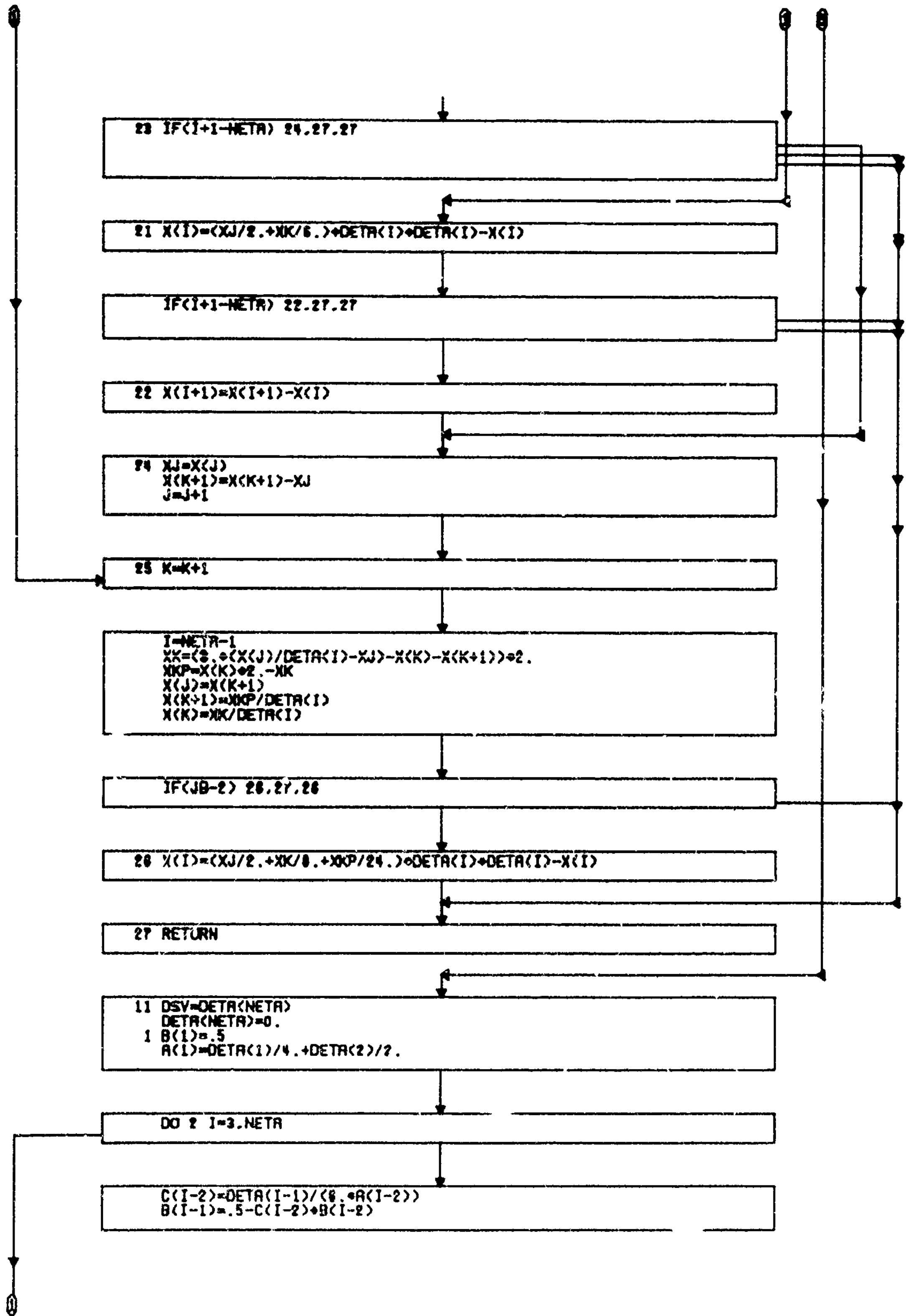
b. Listing

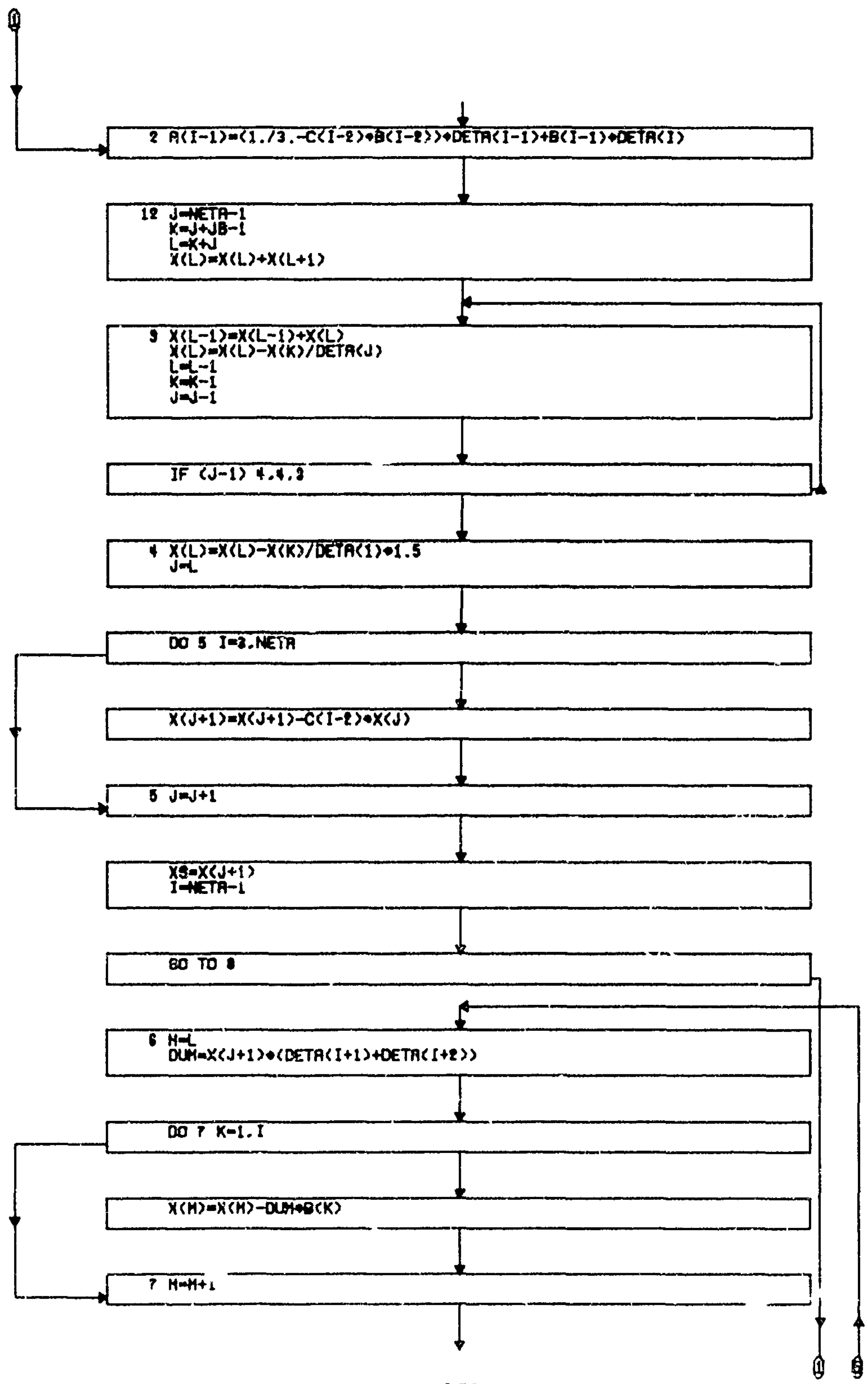
```
      CB18A                                                          B18A 001
            SUBROUTINE MATS1(X)
            COMMON/INTCOM/KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA
            COMMON/ETACOM/ETA(15),DETA(15)                           B18A 004*NEW
            DIMENSION X(1),A(14),B(14),C(14)                         B18A 005*NEW
            IF(KR(1).LT.-50) GO TO 16                                        *NEW
            JB=NETA
            IF(KR(10)-1) 11,18,19
         16 KR(1)=KR(1)+100                                                  *NEW
            JB=2                                                             **-1
            X(NETA)=X(NETA)+X(1)
            IF(KR(10)-1) 11,18,19
         18 LIM=NETA-2
            GO TO 20
         19 LIM=NETA-1
         20 J=JB
            K=JB+NETA-1
            XJ=0.
            DO 25 I=1,LIM
            XK=(X(J)/DETA(I)-XJ)*2.
            X(J)=-X(K)+XK
            X(K)=XK/DETA(I)
            IF(JB-2) 21,23,21
         23 IF(I+1-NETA) 24,27,27
         21 X(I)=(XJ/2.+XK/6.)*DETA(I)*DETA(I)-X(I)
            IF(I+1-NETA) 22,27,27
         22 X(I+1)=X(I+1)-X(I)
         24 XJ=X(J)
            X(K+1)=X(K+1)-XJ
            J=J+1
         25 K=K+1
            I=NETA-1
            XK=(3.*(X(J)/DETA(I)-XJ)-X(K)-X(K+1))*2.
            XKP=X(K)*2.-XK
            X(J)=X(K+1)
            X(K+1)=XKP/DETA(I)
            X(K)=XK/DETA(I)
            IF(JB-2) 26,27,26
         26 X(I)=(XJ/2.+XK/8.+XKP/24.)*DETA(I)*DETA(I)-X(I)
         27 RETURN
         11 DSV=DETA(NETA)
            DETA(NETA)=0.
          1 B(1)=.5
            A(1)=DETA(1)/4.+DETA(2)/2.
            DO 2 I=3,NETA
            C(I-2)=DETA(I-1)/(6.*A(I-2))
            B(I-1)=.5-C(I-2)*B(I-2)
          2 A(I-1)=(1./3.-C(I-2)*B(I-2))*DETA(I-1)+B(I-1)*DETA(I)
         12 J=NETA-1
            K=J+JB-1
            L=K+J
            X(L)=X(L)+X(L+1)
          3 X(L-1)=X(L-1)+X(L)
            X(L)=X(L)-X(K)/DETA(J)
            L=L-1
            K=K-1
            J=J-1
            IF (J-1) 4,4,3
```

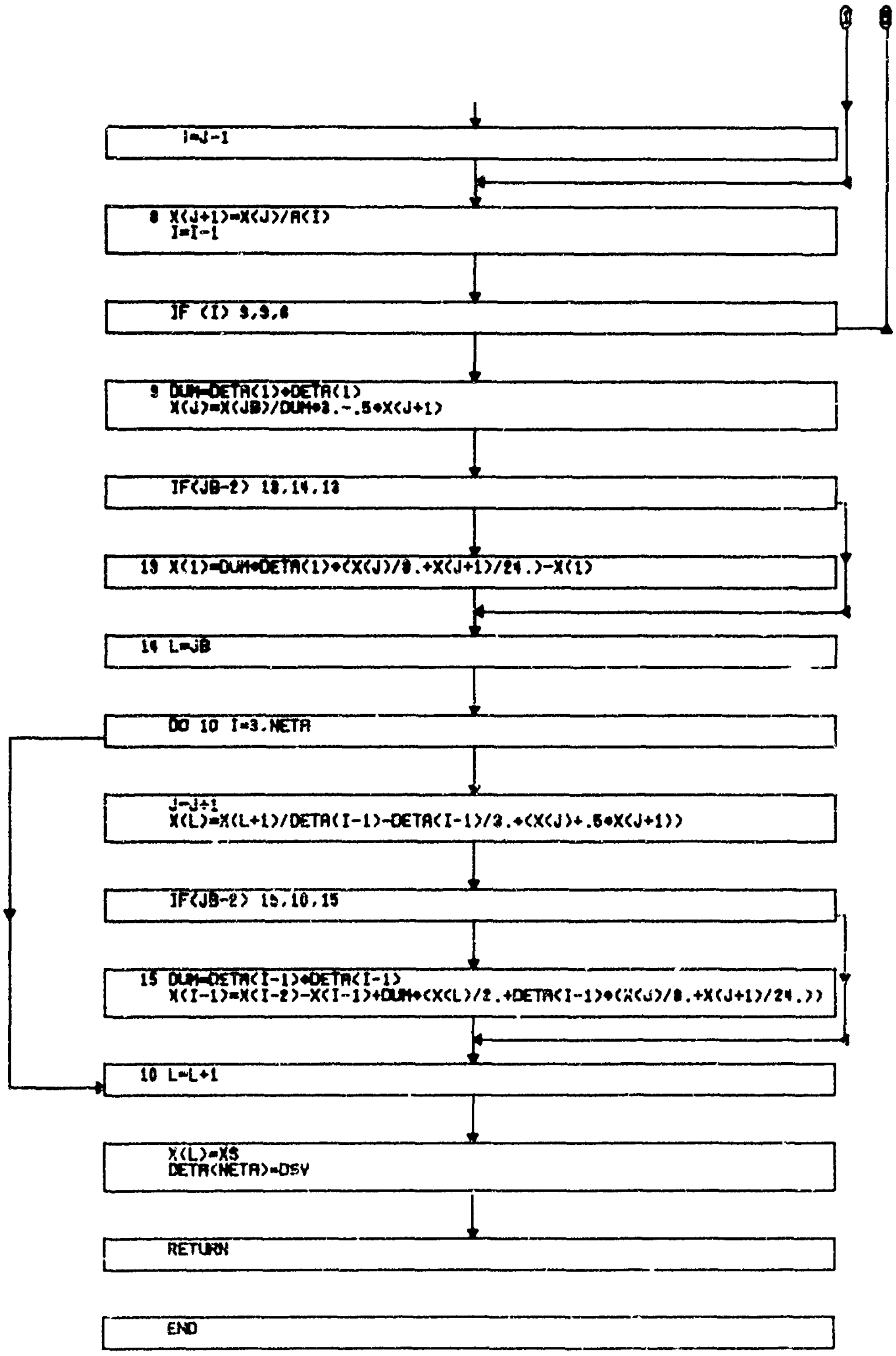
```
    4 X(L)=X(L)-X(K)/DETA(1)*1.5
      J=L
      DO 5 I=3,NETA
      X(J+1)=X(J+1)-C(I-2)*X(J)
    5 J=J+1
      XS=X(J+1)
      I=NETA-1
      GO TO 8
    6 M=L
      DUM=X(J+1)*(DETA(I+1)+DETA(I+2))
      DO 7 K=1,I
      X(M)=X(M)-DUM*B(K)
    7 M=M+1
       J=J-1
    8 X(J+1)=X(J)/A(I)
      I=I-1
      IF (I) 9,9,6
    9 DUM=DETA(1)*DETA(1)
      X(J)=X(JB)/DUM*3.-.5*X(J+1)
      IF(JB-2) 13,14,13
   13 X(1)=DUM*DETA(1)*(X(J)/8.+X(J+1)/24.)-X(1)
   14 L=JB
      DO 10 I=3,NETA
      J=J+1
      X(L)=X(L+1)/DETA(I-1)-DETA(I-1)/3.*(X(J)+.5*X(J+1))
      IF(JB-2) 15,10,15
   15 DUM=DETA(I-1)*DETA(I-1)
      X(I-1)=X(I-2)-X(I-1)+DUM*(X(L)/2.+DETA(I-1)*(X(J)/8.+X(J+1)/24.))
   10 L=L+1
      X(L)=XS
      DETA(NETA)=DSV
      RETURN
      END
```

c. Flow Chart


CB18A
SUBROUTINE MATS1(X)
IF(KR(1).LT.-50) GO TO 18
JB=NETA
IF(KR(10)-1) 11,18,19
11 KR(1)=KR(1)+100
JB=2
X(NETA)=X(NETA)+X(1)
IF(KR(10)-1) 11,18,19
18 LIM=NETA-2
GO TO 20
19 LIM=NETA-1
20 J=JB
K=JB+NETA-1
XJ=0.
DO 25 I=1,LIM
XK=(X(J)/DETA(I)-XJ)*2.
X(J)=-X(K)+XK
X(K)=XK/DETA(_)
IF(JB-2) 21,22,21


23 IF(I+1-NETA) 24,27,27
21 X(I)=(XJ/2.+XK/6.)*DETA(I)*DETA(I)-X(I)
IF(I+1-NETA) 22,27,27
22 X(I+1)=X(I+1)-X(I)
24 XJ=X(J)
X(K+1)=X(K+1)-XJ
J=J+1
25 K=K+1
I=NETA-1
XK=(3.*(X(J)/DETA(I)-XJ)-X(K)-X(K+1))*2.
XKP=X(K)*2.-XK
X(J)=X(K+1)
X(K+1)=XKP/DETA(I)
X(K)=XK/DETA(I)
IF(JB-2) 26,27,26
26 X(I)=(XJ/2.+XK/6.+XKP/24.)*DETA(I)*DETA(I)-X(I)
27 RETURN
11 DSV=DETA(NETA)
DETA(NETA)=0.
1 B(1)=.5
A(1)=DETA(1)/4.+DETA(2)/2.
DO 2 I=3,NETA
C(I-2)=DETA(I-1)/(6.*A(I-2))
B(I-1)=.5-C(I-2)*B(I-2)


2 A(I-1)=(1./3.-C(I-2)*B(I-2))*DETA(I-1)+B(I-1)*DETA(I)
12 J=NETA-1
K=J+JB-1
L=K+J
X(L)=X(L)+X(L+1)
3 X(L-1)=X(L-1)+X(L)
X(L)=X(L)-X(K)/DETA(J)
L=L-1
K=K-1
J=J-1
IF (J-1) 4,4,3
4 X(L)=X(L)-X(K)/DETA(1)*1.5
J=L
DO 5 I=2,NETA
X(J+1)=X(J+1)-C(I-2)*X(J)
5 J=J+1
XS=X(J+1)
I=NETA-1
GO TO 8
6 M=L
DUM=X(J+1)*(DETA(I+1)+DETA(I+2))
DO 7 K=1,I
X(M)=X(M)-DUM*B(K)
7 M=M+1


I=J-1
8 X(J+1)=X(J)/A(I)
I=I-1
IF (I) 9,9,8
9 DUM=DETA(1)*DETA(1)
X(J)=X(JB)/DUM*2.-.5*X(J+1)
IF(JB-2) 13,14,13
13 X(1)=DUM*DETA(1)*(X(J)/8.+X(J+1)/24.)-X(1)
14 L=JB
DO 10 I=3,NETA
J=J+1
X(L)=X(L+1)/DETA(I-1)-DETA(I-1)/2.*(X(J)+.5*X(J+1))
IF(JB-2) 15,10,15
15 DUM=DETA(I-1)*DETA(I-1)
X(I-1)=X(I-2)-X(I-1)+DUM*(X(L)/2.+DETA(I-1)*(X(J)/8.+X(J+1)/24.))
10 L=L+1
X(L)=XS
DETA(NETA)=DSV
RETURN
END

18. SUBROUTINE MATS2 - B18B

a. Function

See MATS1.

b. Listing

```
      CB168
            SUBROUTINE MATS2(X)
            COMMON /INTCOM/ KR(20)
            KR(1)=KR(1)-100
            CALL MATS1(X)
            RETURN
            END
```

c. Flow Chart

```
C0188
      SUBROUTINE MATS2(X)
      COMMON /INTCOM/ KR(20)
      KR(1)=KR(1)-100
      CALL MATS1(X)

      RETURN

      END
```

19. SUBROUTINE TRMBL - B19A

a. Function

Evaluates turbulent transport properties and their derivatives with respect to nonlinear variables. Called by RECASE, NONCER. Calls LIAD.

b. **Listing**

```
      CB19A
            SUBROUTINE TRMBL(ILK)
            DIMENSION EPSOUT(379)
            COMMON/CONCOM/             C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15
           1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,C
           232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4
           3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,C
           465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81
           5,C82,C83,C84,C85,C86,C87,C88
            COMMON/CKFCON/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)
           1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)
           2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)
           3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9)
           4,CKK3( 8, 8)
            COMMON/EDGCOM/             PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,
           1UE(40),RHOE(40),VMUE(40),TE(40), UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)
            COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,
           1EPSA(15),EPS1,EL(15),DPI(15,2),DLI(153),DEPS(153),DEPC,TREF,RETR
            COMMON/ERPCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM
           1,SPLEM( 8),ELM(14),FLMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)
           2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)
           3,FNLEM,GNLEM,SPNLEM( 8),           ENLMM,IFNLM,IGNLM,ISPNLM( 8)
           4,IENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),P1(14),B2(14)
           1,BAR(153),BA1(43,18),BA2(30,15)
            COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14,
           1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHJE,HFW,DLX2
           2,CSM(40),RETAM(40)
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,N
           1S,IT,NTIME,NSP,NSPM1,NAP,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15)
           2,R(F),       MNE,MON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40)
           3,KAUXO,JTIME,JSPEC,MD(3)
            COMMON/MONCOM/AM(153,153),DVNL(153),FCW,
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)
            COMMON/PHPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)
           1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),
           2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)
           3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)
           4,DPHIKK( 8, 8),          DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL
           5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP
           6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH
            EQUIVALENCE(EPSOUT(1),ELCON)
            GO TO (1001,1002,1003,1004,1005),ILK
       1001 CONTINUE
          1 FORMAT(8E10.3)
          2 FORMAT(/30H      MIXING LENGTH CONSTANT  =1PE11.4
           1        /30H      SUBLAYER CONSTANT, YA+  =1PE11.4
           2        /30H      CLAUSER NUMBER          =1PE11.4
           3        /30H      TURBULENT SCHMIDT NUMBER=1PE11.4
           4        /30H      TURBULENT PRANDTL NUMBER=1PE11.4
           5        /30H      TRANSITION MOM.THICK,RE =1PE11.4//)
            READ(KIN,1)  ELCON,YAP,CLNUM,SCT,PRT,RETR
            WRITE(KOUT,2)ELCON,YAP,CLNUM,SCT,PRT,RETR
            KR(10)=1
            KR(7)=KR(7)-2
            IF(RETR.GT.0.) KR(10)=-1
```

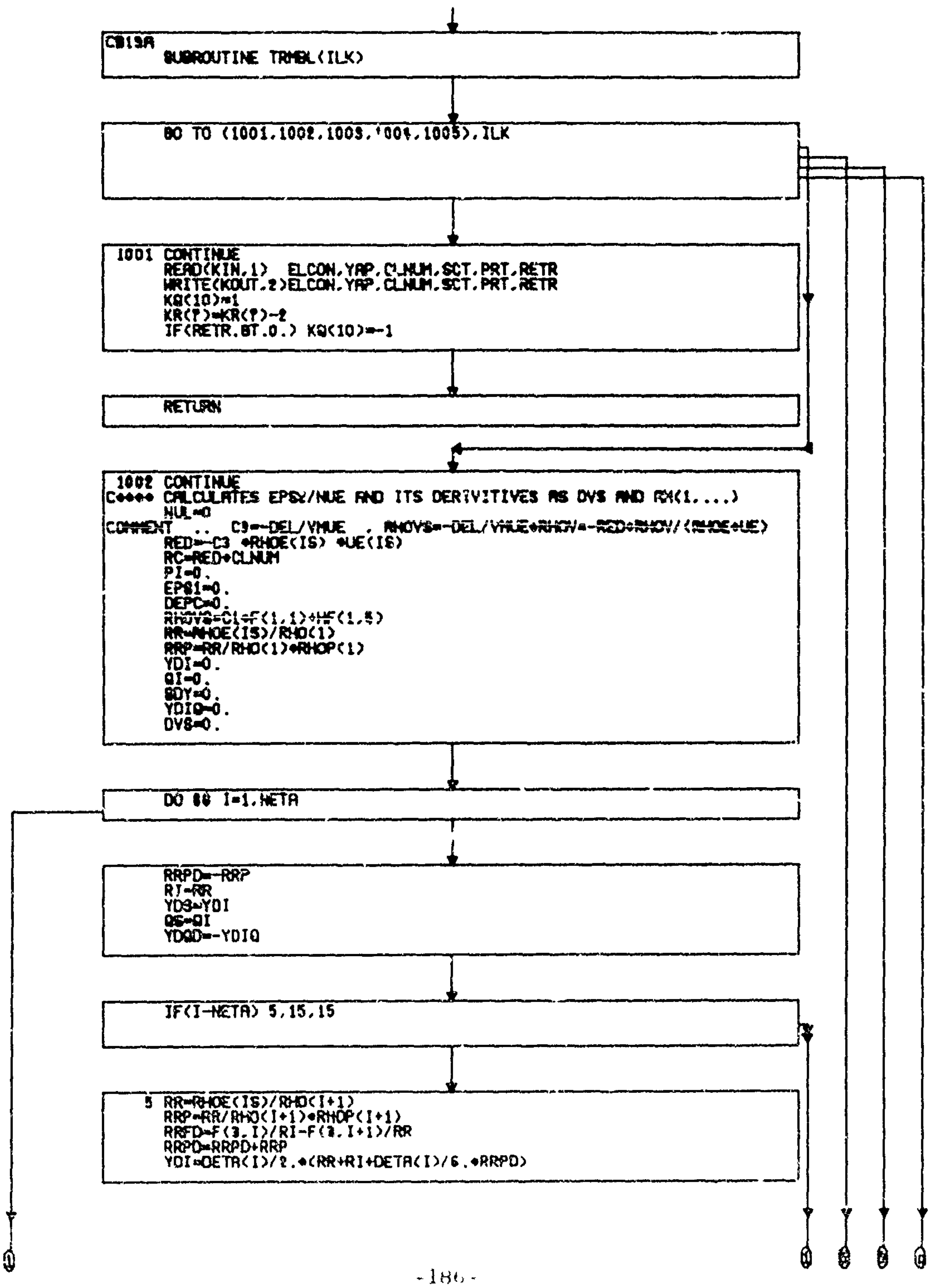
```
      RETURN
 1002 CONTINUE
C**** CALCULATES EPS2/NUE AND ITS DERIVITIVES AS DVS AND AM(1,...)
      NUL=0
COMMENT  ,,  C3=-DEL/VMUE  , RHOVS=-DEL/VMUE*RHOV=-RED*RHOV/(RHOE*UE)
      RED=-C3 *RHOE(IS) *UE(IS)
      RC=RED*CLNUM
      PI=0.
      EPS1=0.
      DEPC=0.
      RHOVS=C1*F(1,1)+HF(1,5)
      RR=RHOE(IS)/RHO(1)
      RRP=RR/RHO(1)*RHOP(1)
      YDI=0.
      QI=0.
      SDY=0.
      YDIQ=0.
      DVS=0.
      DO 66 I=1,NETA
      RRPD=-RRP
      RI=RR
      YDS=YDI
      QS=QI
      YDQD=-YDIQ
      IF(I-NETA) 5,15,15
    5 RR=RHOE(IS)/RHO(I+1)
      RRP=RR/RHO(I+1)*RHOP(I+1)
      RRFD=F(3,I)/RI-F(3,I+1)/RR
      RRPD=RRPD+RRP
      YDI=DETA(I)/2.*(RR+RI+DETA(I)/6.*RRPD)
      SDY=SDY+YDI
      DUM1=YDI/6.*RRFD
      DUM2=F(2,NETA)-(F(2,I)+F(2,I+1))*0.5
      DVS=DVS+YDI*(DUM2-DUM1/2.)
      YDIQ=YDI*YDI
      YDQD=YDQD+YDIQ
      QI=DETA(I)/2.*(DUM2-DUM1)
      QS=QS+QI
      YDS=YDS+YDI
   15 DRHOI=-QS*RI/RHO(I)-F(3,I)/12.*YDQD/RHOE(IS)
      LR=MAT1J+I                                                B19A
      DUM=AM(LR,124)* DRHOI* RC                                 B19A    *NEW
      AM(1,I+3)=AM(1,I+3)-0.5*RC*YDS+C7*DUM*F(2,I)                      **-1
      IF(I-1) 20,20,25
   20 AM(1,3)=AM(1,3)-RC/RI*YDQD/12.
      GO TO 30
   25 CALL LIAD(-1,1,NETA-2+I,-RC/RI*YDQD/12.)
   30 AM(1,1)=AM(1,1)-DUM*C7*F(2,I)*F(2,I)/ALPH
      MPJ=MAT1J+1+I
      DO 60 K=NUL, NSPM1
      IF(K) 40,40,35
   35 LRK=MAT1J+MAT2J+I
      DUM=AM(LR,K+124)* DRHOI* RC                               B19A    *NEW
   40 IF(I-NETA) 50,55,50                                               **-1
   50 AM(1,MPJ)=AM(1,MPJ)+DUM
      GO TO 60
   55 CALL LIAD(K,1,1,DUM)
   60 MPJ=MPJ+MAT2J
      IF(KR(17)) 66,66,65
   65 WRITE (KOUT,640) RC,RR,SDY,RRP,RRPD,RRFD,YDI,YDS,DUM1,DUM2,DVS
```

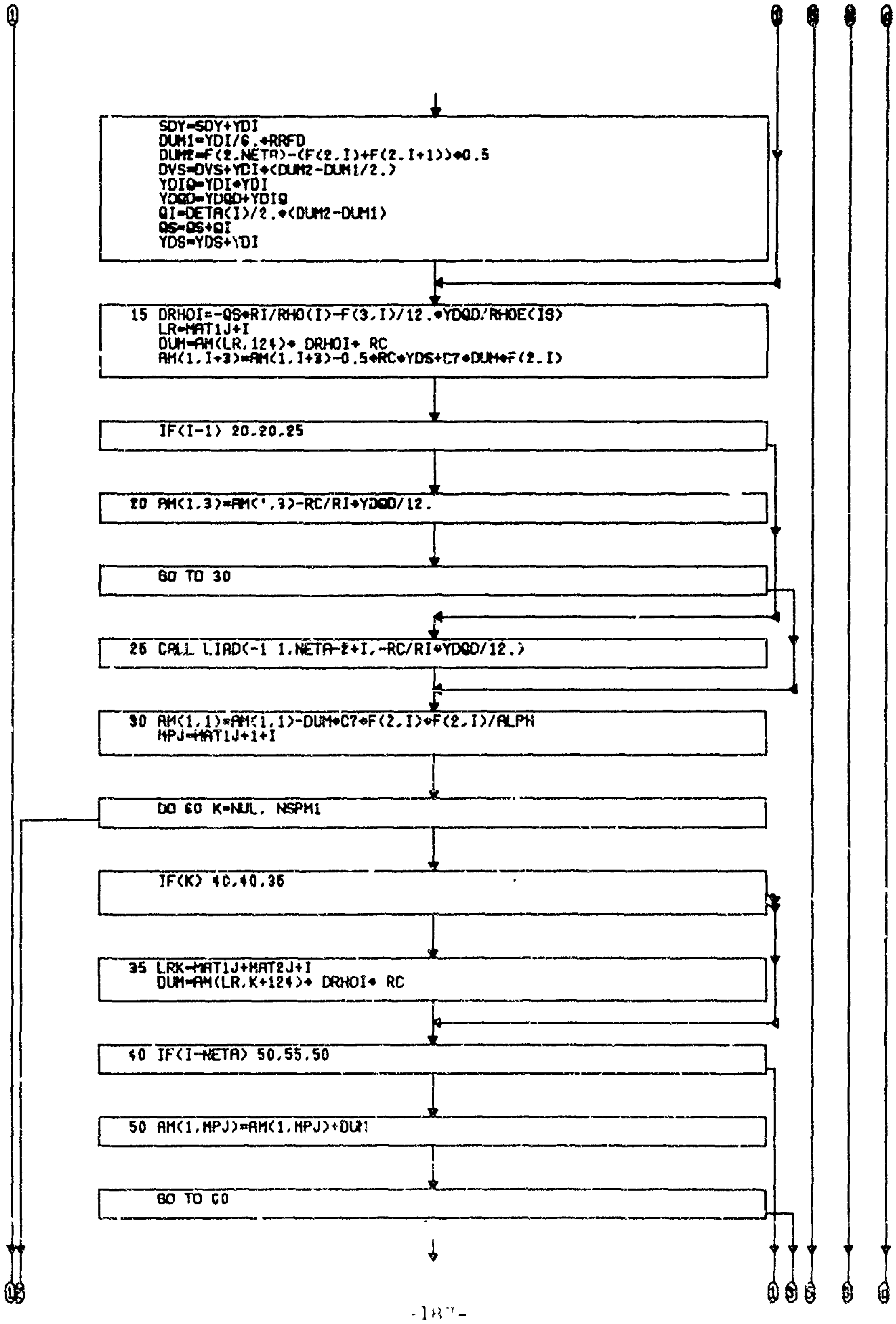
```
     1,YD1Q,YQQ^,31,QS,DRHOI,AM(LR,104),(AM(LRK,K+107),K=1,NSPM1),
     2(AM(1,J), J=1,NNLEQ), ENL(1)
   66 CONTINUE
      DVS=AMAX1(0.,RC*DVS)
      AM(1,MAT1J)=AM(1,MAT1J)+SDY*RC
      RETURN
 1003 CONTINUE
C**** CALCULATES MIXING LENGTH AND ITS DERIVITIVES
  100 PIM=PI
      PI=SQRT(ABS(RED/C26*(CAPC(1)*F(3,1)-ALPH*RHOVS*F(2,I))))/
     1   (CAPC(I)*YAP)
      IF(I-1) 305,305,101
  101 EPI=EXP(-(PI+PIM)/2.*DETA(I-1))
      PID=PI-PIM
      IF(PID/PI-.0001) 102,102,103
  102 PI=AMAX1(PI,PIM)
      PID=1.0
      AF=1.0
      ERP1=1./PI
      ERPP1=-2./(PI*PI)
      ERP2=1./PIM
      ERPP2=-2./(PIM*PIM)
      GO TO 104
  103 AF=SQRT(2./PID*DETA(I-1))
      ERP1=ERP(AF/2.*PI)
      ERPP1=1.-AF*PI*ERP1
      ERP2=ERP(AF/2.*PIM)
      ERPP2=1.-AF*PIM*ERP2
  104 BF=ERP1-EPI*ERP2
      DCLL=EPI
      DUM1=DETA(I-1)/2.*EPI*(AF*ERP2-CL)
      CL=CL*EPI+AF*BF
      EL(I)=ALPH*ELCON*(ETA(I)-CL)
      DUM2=AF/PID*(BF/2.+ERPP1/4.*AF*PI-EPI*ERPP2/4.*AF*PIM)
      DUM3=AF/2.*AF
      DCLPI=DUM1-DUM2+DUM3*ERPP1
      DCLPM=DUM1+DUM2-DUM3*ERPP2*EPI
      IF(I-2) 305,330,320
  305 EL(1)=0.
      DO 307 J=1,NNLEQ
  307 DLI(J)=0.
      CL=0.
      DPI(1,2)= CAPC(1)
      DPI(3,1)= F(3,1)*DCAPCH
      IF(NSPM1) 350,350,310
  310 DO 315 K=1,NSPM1
  315 DPI(K+3,1)= F(3,1) * DCAPCK(K)
      GO TO 350
  320 DO 325 J=1,NNLEQ
  325 DLI(J)= DLI(J) * DCLL
  330 DUM=-TREF*DCLPM*ELCON*ALPH
      DLI(1)= DLI(1)+(EL(I)-DCLL*EL(I-1))/ALPH
      L=I-1
  331 DLI(1)= DLI(1)+DPI(1,1)*DUM
      DLI(2)= DLI(2) + DPI(2,1)* DUM
      DLI(3)= DLI(3) + DPI(1,2)*DUM
      DLI(L+3)= DLI(L+3)+DPI(2,2)*DUM
      J=MAT1J+2
      DO 340 K=NUL,NSPM1
      DLI(J)= DLI(J) + DPI(K+3,1) * DUM
```

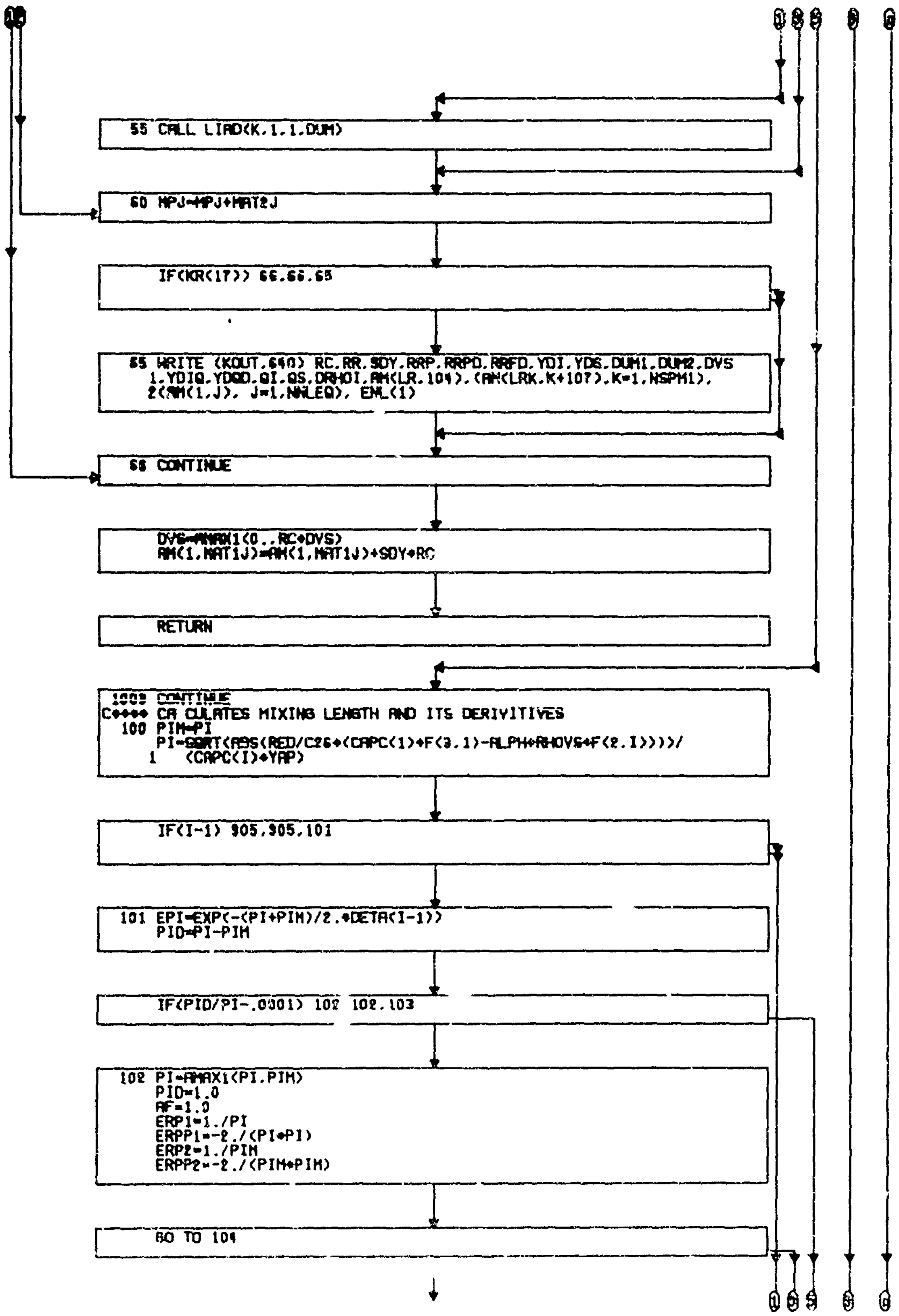
```
      JL=J+L-1
      DLI(JL)= DLI(JL) + DPI(K+3,2)*DUM
  340 J=J+MAT2J
  345 IF(L-I) 350,400,400
  350 TREF= RED/C26 /(2.*CAPC(I)*YAP*PI*YAP*CAPC(I))
      DPI(3,2)=-PI/TREF*(DCAPCH/CAPC(I)-DRHOH/(2.*RHO(I)))
      DPI(2,2)= C10*DPI(3,2)-RHOVS*ALPH
      DPI(1,1)=-C56*C10*DPI(3,2)-RHOVS*F(2,I)
      DPI(2,1)=-ALPH*C1*F(2,I)
      IF(NSPM1) 362,362,355
  355 DO 360 K=1,NSPM1
  360 DPI(K+3,2)=-PI/TREF*(DCAPCK(K)/CAPC(I)-DRHOK(K)/(2.*RHO(I)))
  362 L=I
      DUM=-TREF*DCLPI*ELCON*ALPH
      IF(I-1) 445,445,365
  365 IF(I-NETA) 331,400,400
C**** CALCULATES EPS1 AND EPS2 -- COMPARES TO GET EPS -- CALCULATES EPS
C                                                         DERIVITIVES
  400 DUM1=EL(I)/ALPH*EL(I)/ALPH*RED/C26
      C26S=C26*C26
      EPS1=AMAX1(DUM1*F(3,I),EPS1)
      EPS2=DVS/C26S
      IF(EPS1-EPS2) 405,401,401
  401 EPS=EPS2
      DEPC=ENL(1)/C26S
      DO 402 J=1,NNLEQ
  402 DEPS(J)=AM(1,J)/C26S
      DUM1=2.0*EPS/RHO(I)
      GO TO 415
  405 EPS=EPS1
      DO 410 J=1,NNLEQ
  410 DEPS(J)=2.*EPS / EL(I)*DLI(J)
      DEPS(1)=DEPS(1)-2.0/ALPH*EPS
      LPI=NETA+I-2
      DEPC=-DUM1*PLE(LPI)
      DO 414 J=2,MAT1J
  414 DEPS(J)=DEPS(J)-DUM1*BA1(LPI,J)
      DUM1=EPS/RHO(I)
  415 DUM=DUM1*DRHOH
      EPSA(I)=EPS
      DEPS(1)=DEPS(1)-C56*C10*DUM
      DEPS(I+3)= DEPS(I+3)+DUM*C10
      J=MAT1J+I+1
      L=MAT1J
      DO 420 K=NUL,NSPM1
      IF(I-NETA) 418,416,416
  416 DEPC=DEPC-DUM*SPLE(1,K)
      DO 417 JJ=1,MAT2J
      L=L+1
  417 DEPS(L)=DEPS(L)-DUM*BA2(1,JJ)
      GO TO 419
  418 DEPS(J)=DEPS(J)+DUM
  419 J=J+MAT2J
  420 DUM=DUM1*DRHOK(K+1)
  445 RETURN
 1004 CONTINUE
C**** MODIFIES ENL AND AM AFTER IMONE
      L=I-1
      SALPH=-ALPH/TIVC
      IF(I-2) 650,650,600
```

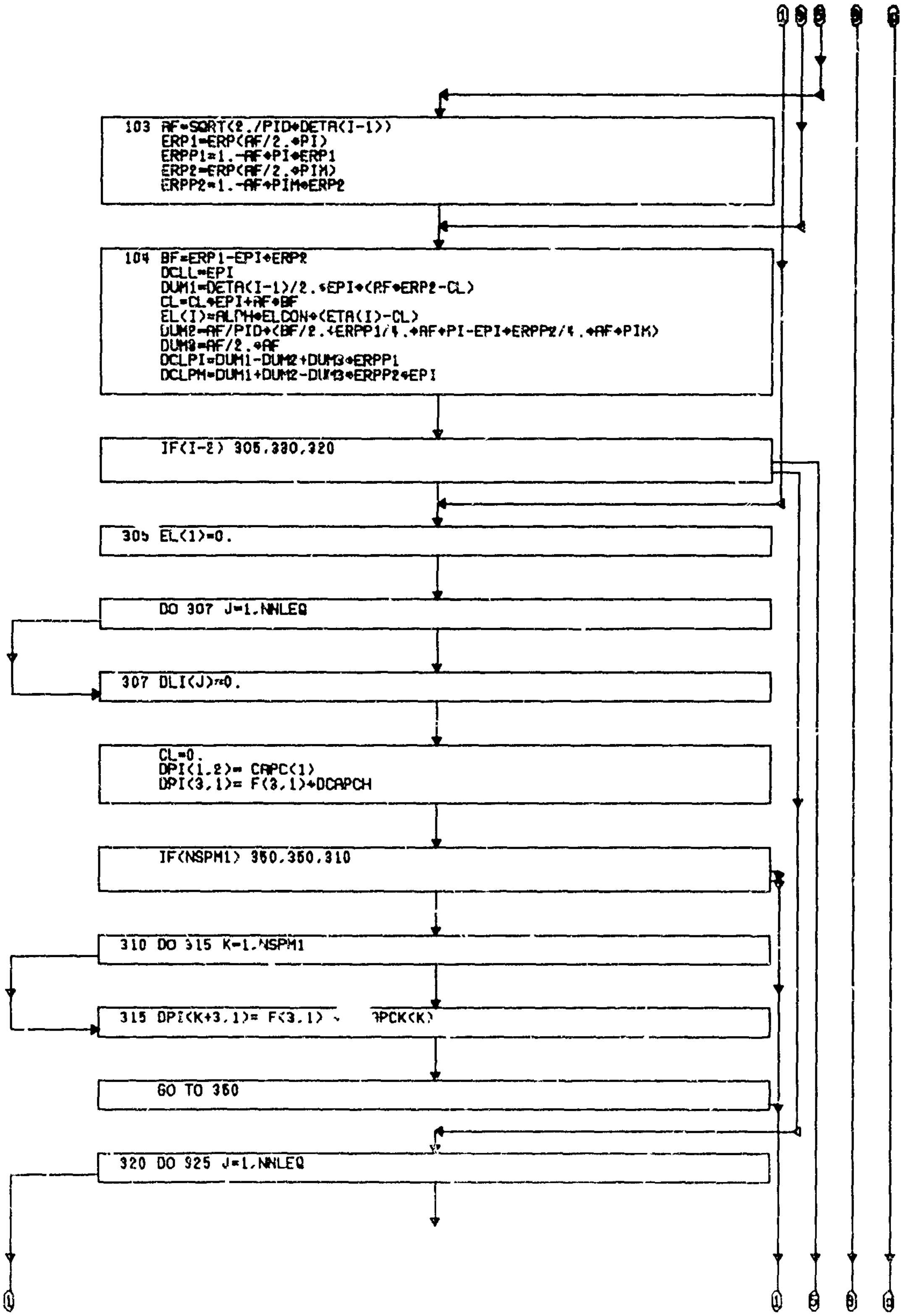
```
 1005 CONTINUE
C**** MODIFIES ENL AND AM AFTER IONLY
      L=I
      SALPH= ALPH/TTVC
  600 IFPP=L+NETA-2
      ISPP=L
      DUM=F(3,L)/SALPH
      ENL(I+3)=ENL(I+3)-DUM*(EPS-DEPC)
      AM(I+3,1)=AM(I+3,1)-DUM*EPS/ALPH
      C28=C28+DUM*EPS
      DO 605 J=1,NNLEQ
  605 AM(I+3,J)=AM(I+3,J)+DUM*DEPS(J)
      CALL LIAD(-1,I+3,IFPP,EPS/SALPH)
      MPJ=MAT1J+I
      PRF=1,-1./PRT
      EG1=G(2,L)/(SALPH*PRT)
      EG3=-EPS/SALPH*PRF*C13*F(2,L)
      EG2=EPS/SALPH*(1,/SCT-1,/PRT)*(HP-CPBAR(L)*TP)
      ENL(MPJ)=ENL(MPJ)-EG1*(EPS-DEPC)-EG2-EG3
      C32=C32+EG1*EPS+EG2*EG3
      AM(MPJ,1)=AM(MPJ,1)-EG1/ALPH*EPS-3.0/ALPH*EG3
      DO 610 J=1,NNLEQ
  610 AM(MPJ,J)=AM(MPJ,J)+(EG1+EG3/EPS)*DEPS(J)
      AM(MPJ,L+3)=AM(MPJ,L+3)-PRF*C13/SALPH*EPS
      CALL LIAD(-1,MPJ,NETA+L-2,-PRF*C10/SALPH*EPS)
      CALL LIAD(0,MPJ,ISPP,EPS/(SALPH*PRT))
      IF(NSPM1) 650,650,615
  615 DO 630 K=1,NSPM1
      DUM=SP(2,L,K)/(SALPH*SCT)
      MPJ=MPJ+MAT2J
      CK6(K)=CK6(K)+DUM*EPS
      ENL(MPJ)=ENL(MPJ)-DUM*(EPS-DEPC)
      AM(MPJ,1)=AM(MPJ,1)-DUM/ALPH*EPS
      DO 620 J=1,NNLEQ
  620 AM(MPJ,J)=AM(MPJ,J)+DUM*DEPS(J)
  630 CALL LIAD(K,MPJ,ISPP,EPS/(SALPH*SCT))
  650 IF(KR(17)) 660,660,655
  655 WRITE(KOUT,640) EPSOUT
  640 FORMAT(/(1P10E12.5))
  660 RETURN
      END
```

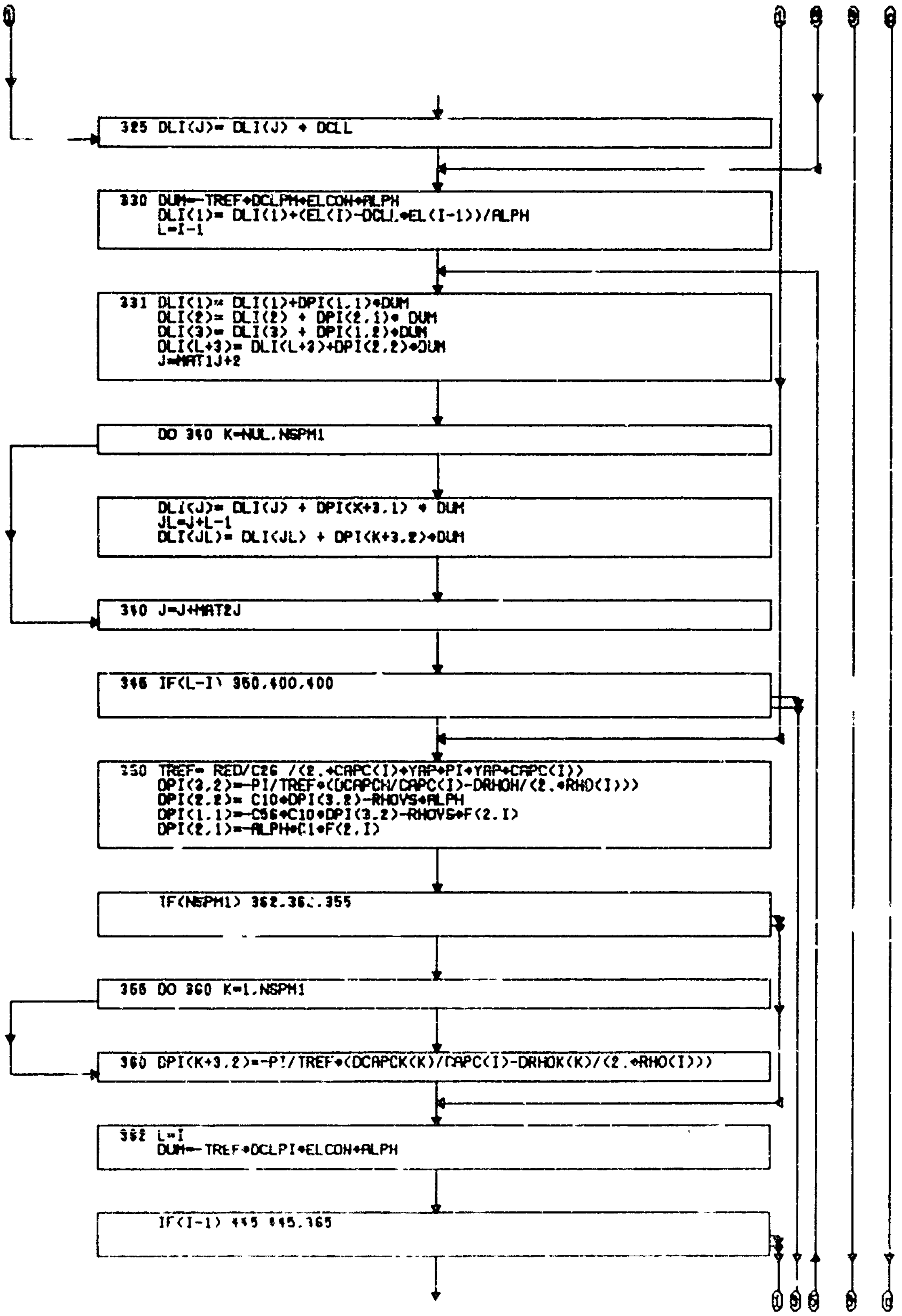
c. Flow Chart

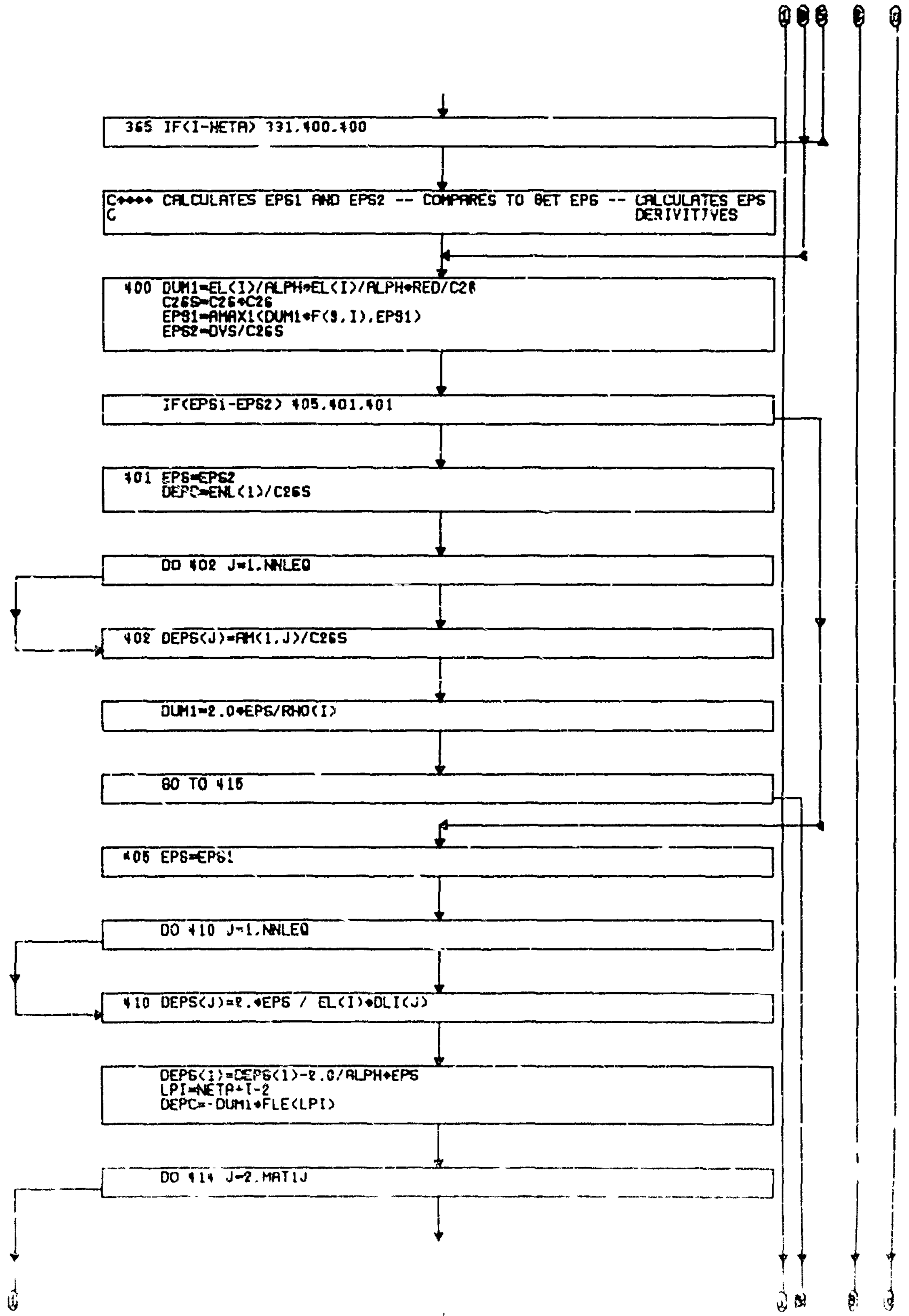

C819A
SUBROUTINE TRMBL(ILK)
GO TO (1001,1002,1003,1004,1005),ILK
1001 CONTINUE
READ(KIN,1) ELCON,YAP,CLNUM,SCT,PRT,RETR
WRITE(KOUT,2)ELCON,YAP,CLNUM,SCT,PRT,RETR
KQ(10)=1
KR(7)=KR(7)-2
IF(RETR.GT.0.) KQ(10)=-1
RETURN
1002 CONTINUE
C**** CALCULATES EPS2/NUE AND ITS DERIVITIVES AS DVS AND RX(1,...)
NUL=0
COMMENT .. C3=-DEL/VMUE , RHOVS=-DEL/VMUE*RHOV=-RED*RHOV/(RHOE*UE)
RED=-C3 *RHOE(IS) *UE(IS)
RC=RED*CLNUM
PI=0.
EPS1=0.
DEPC=0.
RHOVS=C1*F(1,1)+HF(1,5)
RR=RHOE(IS)/RHO(1)
RRP=RR/RHO(1)*RHOP(1)
YDI=0.
QI=0.
SDY=0.
YDIQ=0.
DVS=0.
DO 80 I=1,NETA
RRPD=-RRP
RI=RR
YDS=YDI
QS=QI
YDQD=-YDIQ
IF(I-NETA) 5,15,15
5 RR=RHOE(IS)/RHO(I+1)
RRP=RR/RHO(I+1)*RHOP(I+1)
RRFD=F(3,I)/RI-F(3,I+1)/RR
RRPD=RRPD+RRP
YDI=DETA(I)/2.*(RR+RI+DETA(I)/6.*RRPD)

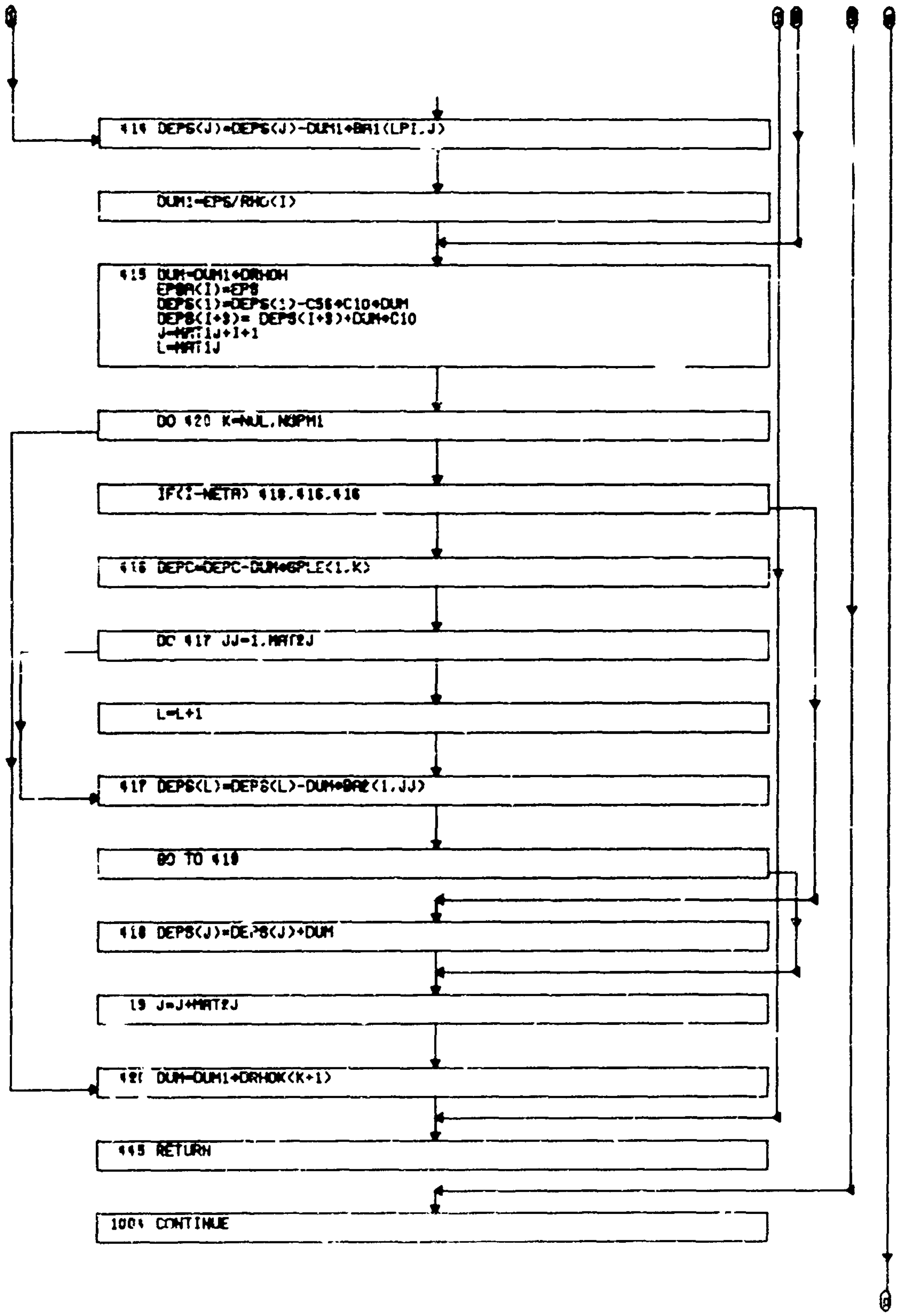

SDY=SDY+YDI
DUM1=YDI/6.*RRFD
DUM2=F(2,NETA)-(F(2,I)+F(2,I+1))*0.5
DVS=DVS+YDI*(DUM2-DUM1/2.)
YDIQ=YDI*YDI
YDQD=YDQD+YDIQ
QI=DETA(I)/2.*(DUM2-DUM1)
QS=QS+QI
YDS=YDS+YDI
15 DRHOI=-QS*RI/RHO(I)-F(3,I)/12.*YDQD/RHOE(IS)
LR=MAT1J+I
DUM=AM(LR,124)* DRHOI* RC
AM(1,I+3)=AM(1,I+3)-0.5*RC*YDS+C7*DUM*F(2,I)
IF(I-1) 20,20,25
20 AM(1,3)=AM(',3)-RC/RI*YDQD/12.
GO TO 30
25 CALL LIAD(-1 1,NETA-2+I,-RC/RI*YDQD/12.)
30 AM(1,1)=AM(1,1)-DUM*C7*F(2,I)*F(2,I)/ALPH
MPJ=MAT1J+1+I
DO 60 K=NUL, NSPM1
IF(K) 40,40,35
35 LRK=MAT1J+MAT2J+I
DUM=AM(LR,K+124)* DRHOI* RC
40 IF(I-NETA) 50,55,50
50 AM(1,MPJ)=AM(1,MPJ)+DUM
GO TO 60

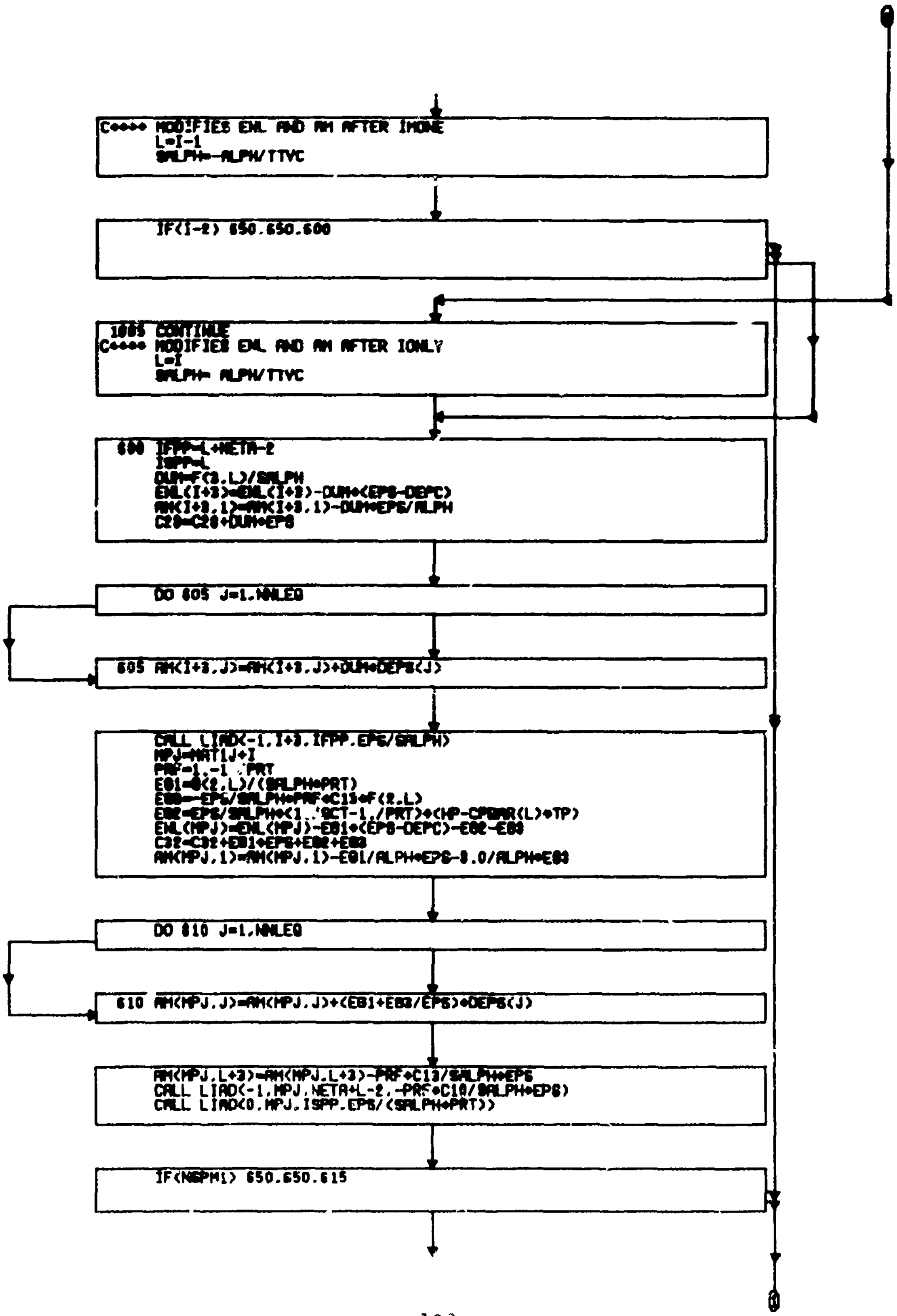

55 CALL LIAD(K.1.1.DUM)
60 MPJ=MPJ+MAT2J
IF(KR(17)) 66.66.65
65 WRITE (KOUT.640) RC.RR.SDY.RRP.RRPD.RRFD.YDI.YDS.DUM1.DUM2.DVS
1.YDIQ.YDQD.QI.QS.DRHOI.AM(LR.104).(AM(LRK.K+107).K=1.NSPM1).
2(AM(1.J). J=1.NNLEQ). EML(1)
66 CONTINUE
DVS=AMAX1(0..RC+DVS)
AM(1.MAT1J)=AM(1.MAT1J)+SDY+RC
RETURN
1002 CONTINUE
C**** CA CULATES MIXING LENGTH AND ITS DERIVITIVES
100 PIM=PI
PI=SQRT(ABS(RED/C26*(CAPC(1)+F(3.1)-ALPH*RHOVS*F(2.I))))/
1 (CAPC(I)*YAP)
IF(I-1) 905,905,101
101 EPI=EXP(-(PI+PIM)/2.*DETA(I-1))
PID=PI-PIM
IF(PID/PI-.0001) 102 102.103
102 PI=AMAX1(PI.PIM)
PID=1.0
AF=1.0
ERP1=1./PI
ERPP1=-2./(PI*PI)
ERP2=1./PIM
ERPP2=-2./(PIM*PIM)
GO TO 104

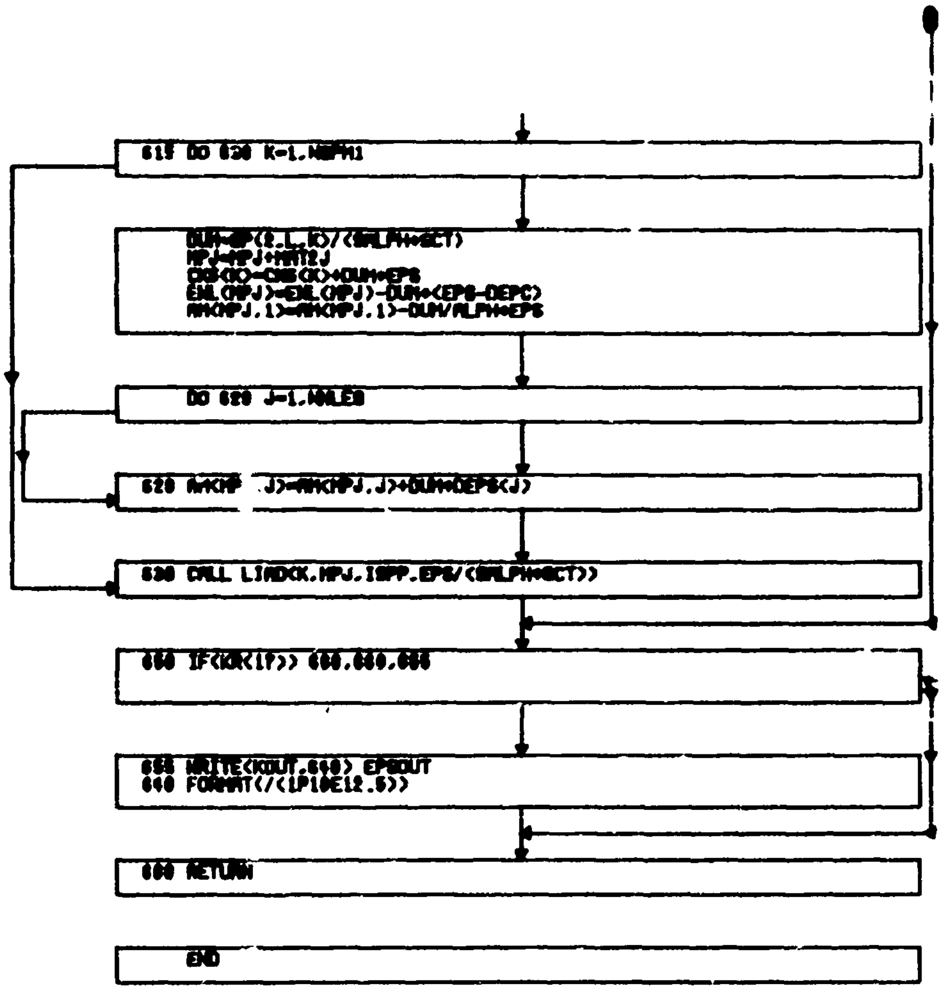

103 AF=SQRT(2./PID*DETA(I-1))
ERP1=ERP(AF/2.*PI)
ERPP1=1.-AF*PI*ERP1
ERP2=ERP(AF/2.*PIM)
ERPP2=1.-AF*PIM*ERP2
104 BF=ERP1-EPI*ERP2
DCLL=EPI
DUM1=DETA(I-1)/2.*EPI*(AF*ERP2-CL)
CL=CL*EPI+AF*BF
EL(I)=ALPH*ELCON*(ETA(I)-CL)
DUM2=AF/PID*(BF/2.+ERPP1/4.*AF*PI-EPI*ERPP2/4.*AF*PIM)
DUM3=AF/2.*AF
DCLPI=DUM1-DUM2+DUM3*ERPP1
DCLPM=DUM1+DUM2-DUM3*ERPP2*EPI
IF(I-2) 305,330,320
305 EL(1)=0.
DO 307 J=1,NNLEQ
307 DLI(J)=0.
CL=0.
DPI(1,2)= CAPC(1)
DPI(3,1)= F(3,1)+DCAPCH
IF(NSPM1) 350,350,310
310 DO 315 K=1,NSPM1
315 DPI(K+3,1)= F(3,1) + PCK(K)
GO TO 350
320 DO 325 J=1,NNLEQ


325 DLI(J)= DLI(J) + DCLL
330 DUM=-TREF*DCLPM*ELCON*ALPH
DLI(1)= DLI(1)+(EL(I)-DCLL*EL(I-1))/ALPH
L=I-1
331 DLI(1)= DLI(1)+DPI(1,1)*DUM
DLI(2)= DLI(2) + DPI(2,1)* DUM
DLI(3)= DLI(3) + DPI(1,2)*DUM
DLI(L+3)= DLI(L+3)+DPI(2,2)*DUM
J=MAT1J+2
DO 340 K=NUL,NSPM1
DLI(J)= DLI(J) + DPI(K+3,1) * DUM
JL=J+L-1
DLI(JL)= DLI(JL) + DPI(K+3,2)*DUM
340 J=J+MAT2J
345 IF(L-I) 350,400,400
350 TREF= RED/C26 /(2.*CAPC(I)*YAP*PI*YAP*CAPC(I))
DPI(3,2)=-PI/TREF*(DCAPCH/CAPC(I)-DRHOH/(2.*RHO(I)))
DPI(2,2)= C10*DPI(3,2)-RHOVS*ALPH
DPI(1,1)=-C56*C10*DPI(3,2)-RHOVS*F(2,I)
DPI(2,1)=-ALPH*C1*F(2,I)
IF(NSPM1) 362,362,355
355 DO 360 K=1,NSPM1
360 DPI(K+3,2)=-PI/TREF*(DCAPCK(K)/CAPC(I)-DRHOK(K)/(2.*RHO(I)))
362 L=I
DUM=-TREF*DCLPI*ELCON*ALPH
IF(I-1) 445,445,365


365 IF(I-NETA) 331,400,400
C**** CALCULATES EPS1 AND EPS2 -- COMPARES TO GET EPS -- CALCULATES EPS
C DERIVITIVES
400 DUM1=EL(I)/ALPH*EL(I)/ALPH*RED/C26
C26S=C26*C26
EPS1=AMAX1(DUM1*F(3,I),EPS1)
EPS2=DVS/C26S
IF(EPS1-EPS2) 405,401,401
401 EPS=EPS2
DEPC=ENL(1)/C26S
DO 402 J=1,NNLEQ
402 DEPS(J)=AM(1,J)/C26S
DUM1=2.0*EPS/RHO(I)
GO TO 416
405 EPS=EPS1
DO 410 J=1,NNLEQ
410 DEPS(J)=2.*EPS / EL(I)*DLI(J)
DEPS(1)=DEPS(1)-2.0/ALPH*EPS
LPI=NETA+I-2
DEPC=-DUM1*FLE(LPI)
DO 414 J=2,MATIJ


414 DEPS(J)=DEPS(J)-DUM1*BR1(LPI,J)
DUM1=EPS/RHO(I)
415 DUM=DUM1*DRHOH
EPSA(I)=EPS
DEPS(1)=DEPS(1)-CS8*C10*DUM
DEPS(I+3)= DEPS(I+3)+DUM*C10
J=MAT1J+I+1
L=MAT1J
DO 420 K=NUL,NOPM1
IF(I-NETR) 418,416,416
416 DEPC=DEPC-DUM*SPLE(1,K)
DO 417 JJ=1,MAT2J
L=L+1
417 DEPS(L)=DEPS(L)-DUM*BR2(1,JJ)
GO TO 419
418 DEPS(J)=DEPS(J)+DUM
19 J=J+MAT2J
420 DUM=DUM1*DRHOK(K+1)
445 RETURN
1004 CONTINUE


C**** MODIFIES ENL AND AM AFTER IMONE
L=I-1
SALPH=-ALPH/TTVC
IF(I-2) 650.650.600
1005 CONTINUE
C**** MODIFIES ENL AND AM AFTER IONLY
L=I
SALPH= ALPH/TTVC
600 IFPP=L+NETA-2
ISPP=L
DUM=F(3.L)/SALPH
ENL(I+3)=ENL(I+3)-DUM*(EPS-DEPC)
AM(I+3.1)=AM(I+3.1)-DUM*EPS/ALPH
C28=C28+DUM*EPS
DO 605 J=1.NNLEQ
605 AM(I+3.J)=AM(I+3.J)+DUM*DEPS(J)
CALL LIAD(-1.I+3.IFPP.EPS/SALPH)
MPJ=MAT1J+I
PRF=1.-1./PRT
E01=G(2.L)/(SALPH*PRT)
E03=-EPS/SALPH*PRF*C13*F(2.L)
E02=EPS/SALPH*(1./SCT-1./PRT)*(HP-CPBAR(L)*TP)
ENL(MPJ)=ENL(MPJ)-E01*(EPS-DEPC)-E02-E03
C32=C32+E01*EPS+E02+E03
AM(MPJ.1)=AM(MPJ.1)-E01/ALPH*EPS-3.0/ALPH*E03
DO 610 J=1.NNLEQ
610 AM(MPJ.J)=AM(MPJ.J)+(E01+E03/EPS)*DEPS(J)
AM(MPJ.L+3)=AM(MPJ.L+3)-PRF*C13/SALPH*EPS
CALL LIAD(-1.MPJ.NETA+L-2.-PRF*C10/SALPH*EPS)
CALL LIAD(0.MPJ.ISPP.EPS/(SALPH*PRT))
IF(NGPM1) 650.650.615


615 DO 630 K=1.NSPM1
DUM=SP(2.L.K)/(SALPH*SCT)
MPJ=MPJ+NNT2J
CNS(K)=CNS(K)+DUM*EPS
ENL(MPJ)=ENL(MPJ)-DUM*(EPS-DEPC)
AN(MPJ.1)=AN(MPJ.1)-DUM/ALPH*EPS
DO 620 J=1.NNLEB
620 AN(MP .J)=AN(MPJ.J)+DUM*DEPS(J)
630 CALL LINDX(K.MPJ.ISPP.EPS/(SALPH*SCT))
650 IF(KR(17)) 660.660.655
655 WRITE(KOUT.640) EPSOUT
640 FORMAT(/(1P10E12.5))
660 RETURN
END

20. SUBROUTINE TRANCR - B19T

a. Function

Evaluate terms required for consideration of transverse curvature. Called by SETUP, NONCER. Calls SLOPQ.

b. Listing

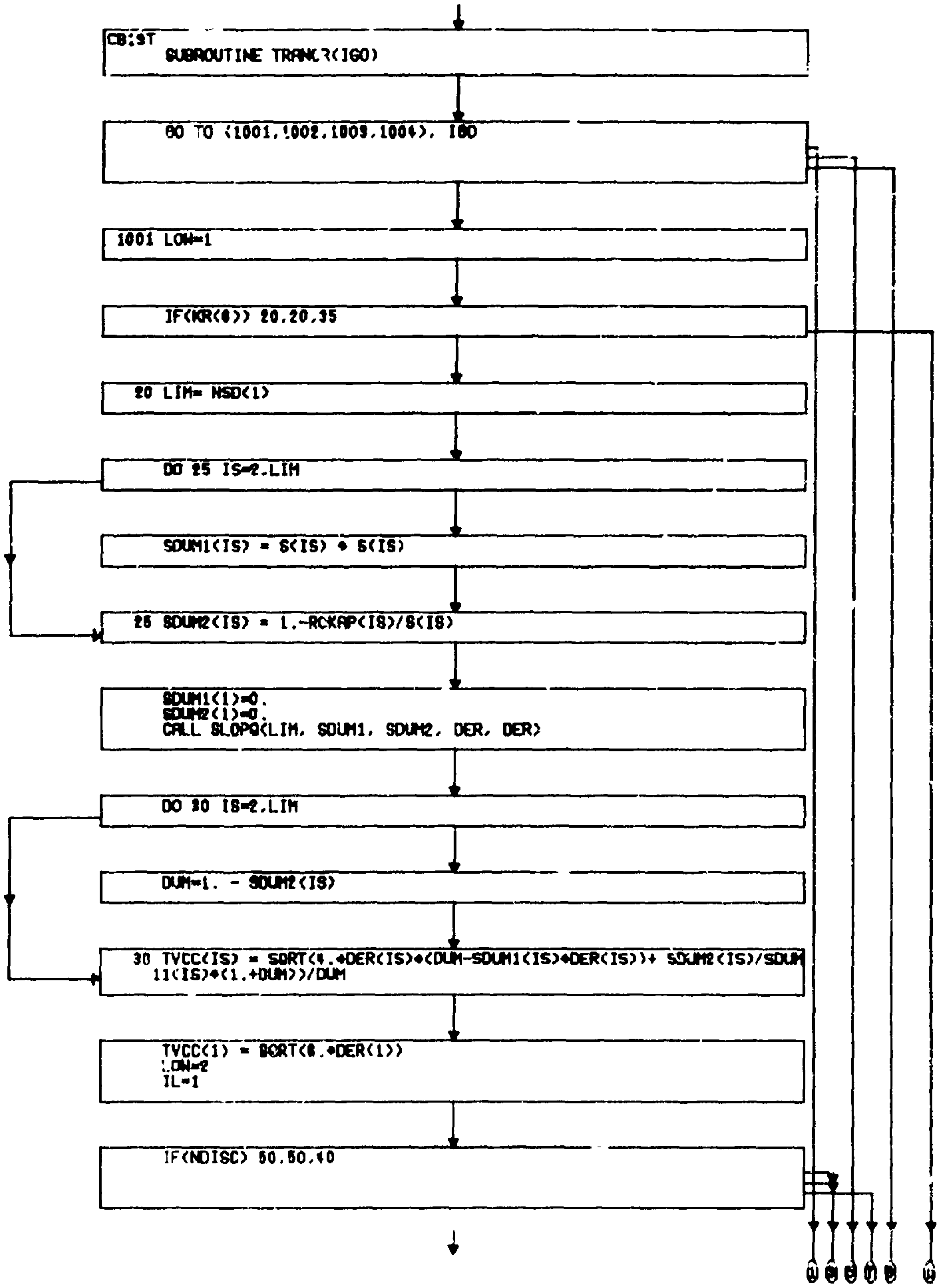
```
      CB19T
            SUBROUTINE TRANCR(IGO)                                             *NEW
            DIMENSION DRH3(153)                                           B19T 003*NEW
            COMMON/COECOM/            C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15B19T   4*NEW
           1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,CB19T   5*NEW
           232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4B19T   6*NEW
           3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,CB19T   7*NEW
           465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81B19T   8*NEW
           5,C82,C83,C84,C85,C86,C87,C88                                  B19T   9*NEW
            COMMON/COECON/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)   B19T  10*NEW
           1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)    B19T  11*NEW
           2,CK14( 8),CK15( 8),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)  B19T  12*NEW
           3,CK21( 8),CK22( 8),CKK1( 8, 8),CKK2( 8, 8),XM(5),XG(5),XSP(5, 9) B19T  13*NEW
           4,CKK3( 8, 8)                                                   B19T  14*NEW
            COMMON/EDGCOM/          PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B19T  15*NEW
           1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C9?  B19T  16*NEW
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                 B19T  17*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14)    B19T  18*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                                B19T  19*NEW
            COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14) ZG(4,14),ZSP(4,14, 8B19T  20*NEW
           1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  B19T  21*NEW
           2,C3M(40),BETAM(40)                                             B19T  22*NEW
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB19T  23*NEW
           1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B19T  24*NEW
           2,B(8),      MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B19T  25*NEW
           3,KAUXO,JTIME,JSPEC,MD(3)                                       B19T  26*NEW
            COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                        B19T  27*NEW
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)            B19T  28*NEW
            COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B19T  29*NEW
           1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B19T  30*NEW
           2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                         B19T  31*NEW
            COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)  B19T  32*NEW
           1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB19T  33*NEW
           2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B19T  34*NEW
           3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)  B19T  35*NEW
           4,DPHIKK( 8, 8),     DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL   B19T  36*NEW
           5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B19T  37*NEW
           6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)  B19T  38*NEW
            COMMON/TEMCOM/SPDUM( 8),DER(40),DUMM1(15),SLOPE(15),REDUM(15)    B19T  39*NEW
           1,SDUM1(40),SDUM2(40),FWDUM(40),XICON(40),FWCON(40),FWINIT( 1)    B19T  40*NEW
           2,XIINIT( 1),DUDS( 40)                                          B19T  41*NEW
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                  B19T  42*NEW
            GO TO (1001,1002,1003,1004), IGO                                   *NEW
       1001 LOW=1                                                              *NEW
            IF(KR(6)) 20,20,35                                                 *-43
         20 LIM= NSD(1)
            DO 25 IS=2,LIM
            SDUM1(IS) = S(IS) * S(IS)
         25 SDUM2(IS) = 1.-ROKAP(IS)/S(IS)
            SDUM1(1)=0.
            SDUM2(1)=0.
            CALL SLOPQ(LIM, SDUM1, SDUM2, DER, DER)
            DO 30 IS=2,LIM
            DUM=1. - SDUM2(IS)
         30 TVCC(IS) = SQRT(4.*DER(IS)*(DUM*SDUM1(IS)*DER(IS))+ SDUM2(IS)/SDUM
           11(IS)*(1.+DUM))/DUM
            TVCC(1) = SQRT(6.*DER(1))
            LOW=2
```

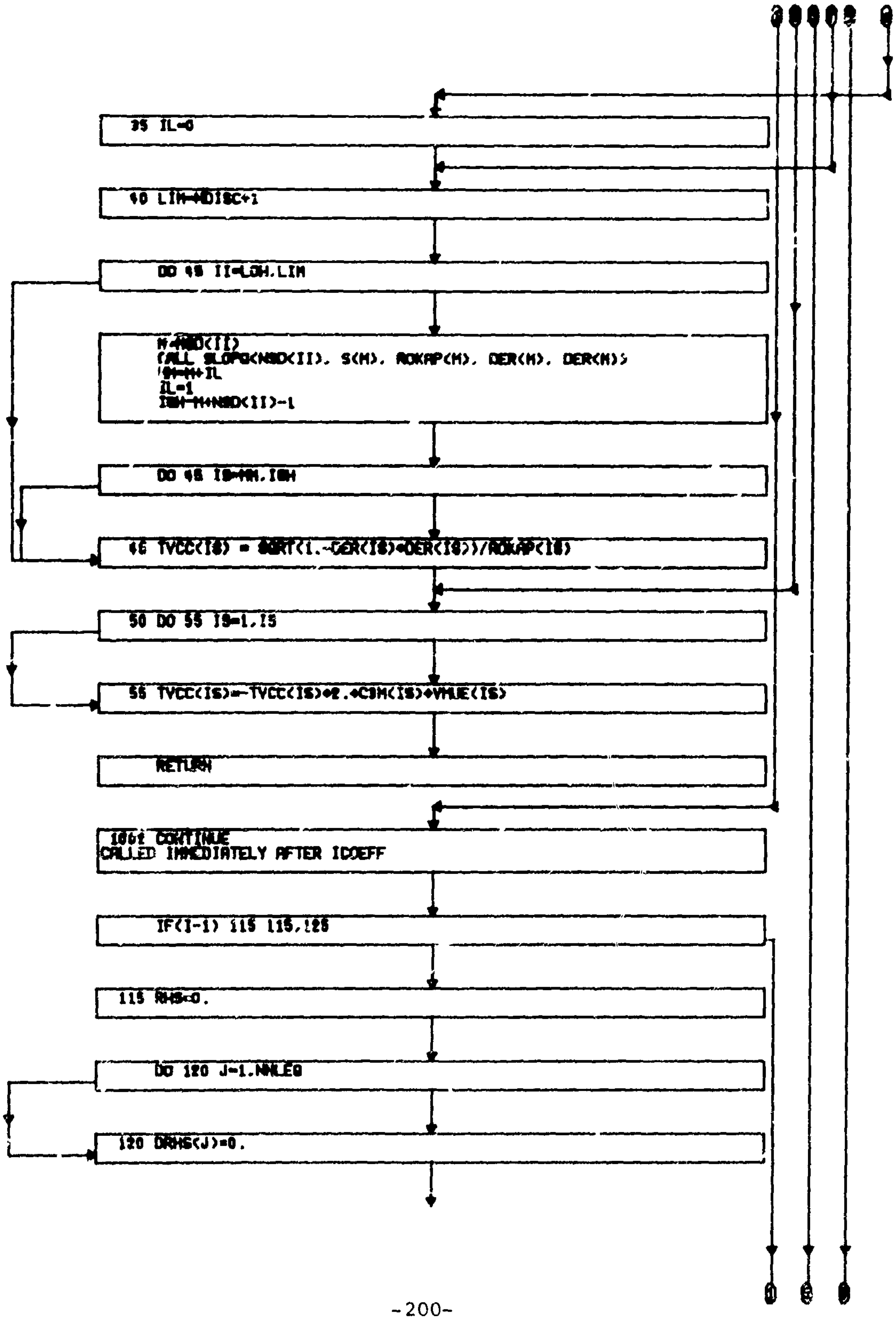
```
          IL=1
          IF(NDISC) 50,50,40
       35 IL=0
       40 LIM=NDISC+1
          DO 45 II=LOW,LIM
          M=MSD(II)
          CALL SLOPO(NSD(II), S(M), ROKAP(M), DER(M), DER(M))
          MM=M+IL
          IL=1
          IGH=M+NSD(II)-1
          DO 45 IS=MM,IGH
       45 TVCC(IS) = SQRT(1.-DER(IS)*DER(IS))/ROKAP(IS)
       50 DO 55 IS=1,IS
       55 TVCC(IS)=-TVCC(IS)*2.*C3M(IS)*VMUE(IS)
          RETURN
     1002 CONTINUE                                                               *NEW
   CALLED IMMEDIATELY AFTER ICOEFF                                               **-1
          IF(I-1) 115,115,125
      115 RHS=0.
          DO 120 J=1,NNLEQ
      120 DRHS(J)=0.
          GO TO 130
      125 IND=I-1
          SIX=-6.
          GO TO 140
      130 IND=I
          SIX=6.
          C27=DRHOH
          DO 135 K=1,NSPM1
      135 CK11(K)=DRHOK(K)
          IF(I-1) 165,165,140
      140 DUM=DETA(I-1)/2. *RHOE(IS)/RHO(IND)
          IF(KQ(9).LT.0) DUM=-DUM
          RHS=RHS+DUM*(1.+RHOP(IND)/RHO(IND)*DETA(I-1)/SIX)
          DUM=-DUM/RHO(IND)
          LPS=MAT1J+IND+1
          IF(NSPM1) 155,155,145
      145 LPI=LPS
          DO 150 K=1,NSPM1
          LPI=LPI+MAT2J
      150 DRHS(LPI)=DRHS(LPI)+DUM*CK11(K)
      155 DUM=DUM*C27
          DRHS(LPS) = DRHS(LPS) + DUM
          DUM=DUM*C7*F(2,IND)
          DRHS(IND+3) = DRHS(IND+3) + DUM
          DRHS(1)= DRHS(1)-DUM/ALPH*F(2,IND)
          IF(IND-I) 130,160,160
      160 TTVC=AMAX1(1.+RHS*ALPH*TVCC(IS),0.0001)
      165 RETURN
     1003 CONTINUE                                                               *NEW
   CALLED IMMEDIATELY AFTER IMONE                                                **-1
          IND=I-1
          DUM1=-TVCC(IS)/TTVC
          GO TO 205

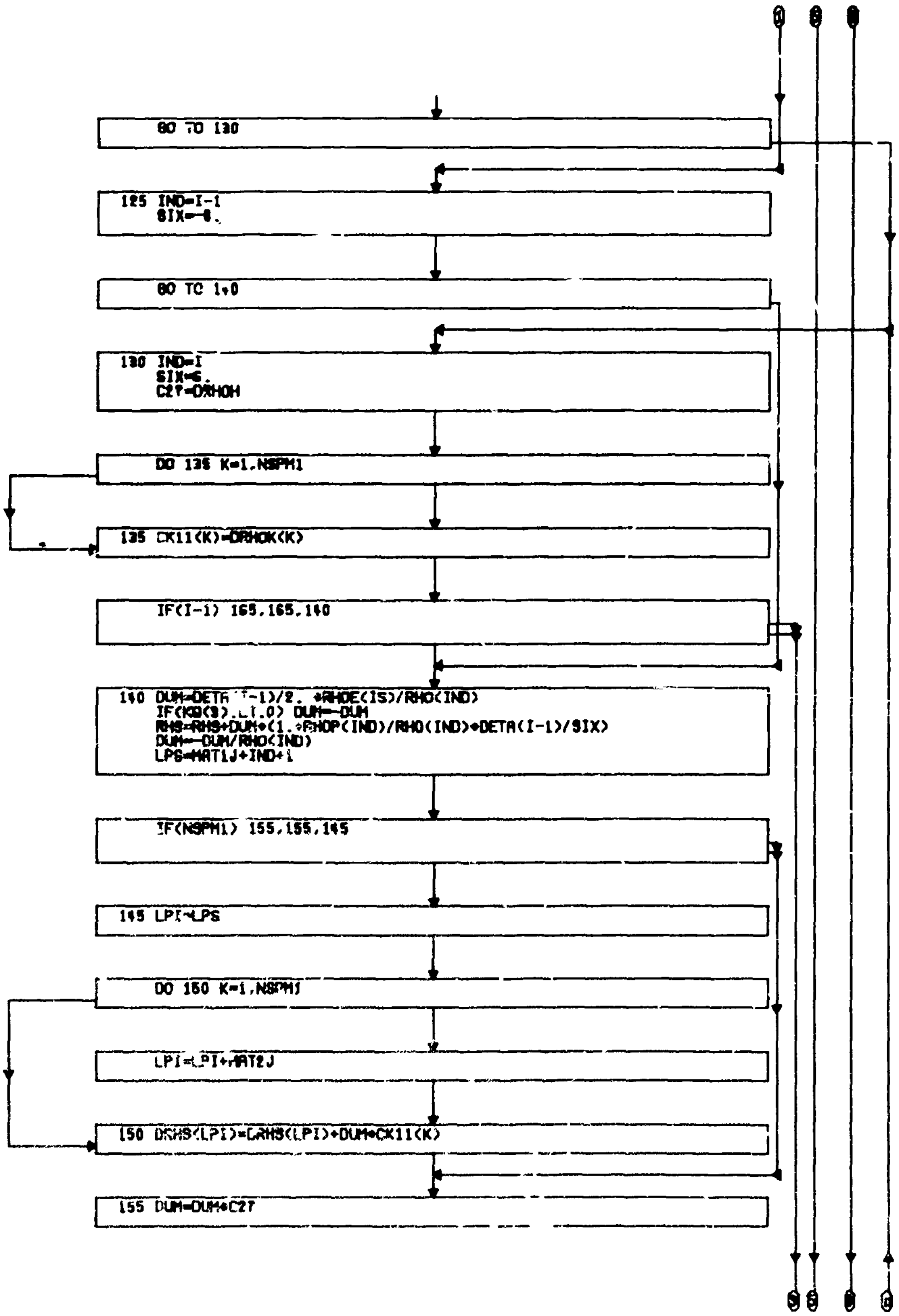
     1004 CONTINUE                                                               *NEW
          IND=I                                                                  **-1
          DUM1=TVCC(IS)/TTVC
      205 DUM2=DUM1*C28
          DUM3=DUM1* C32
```

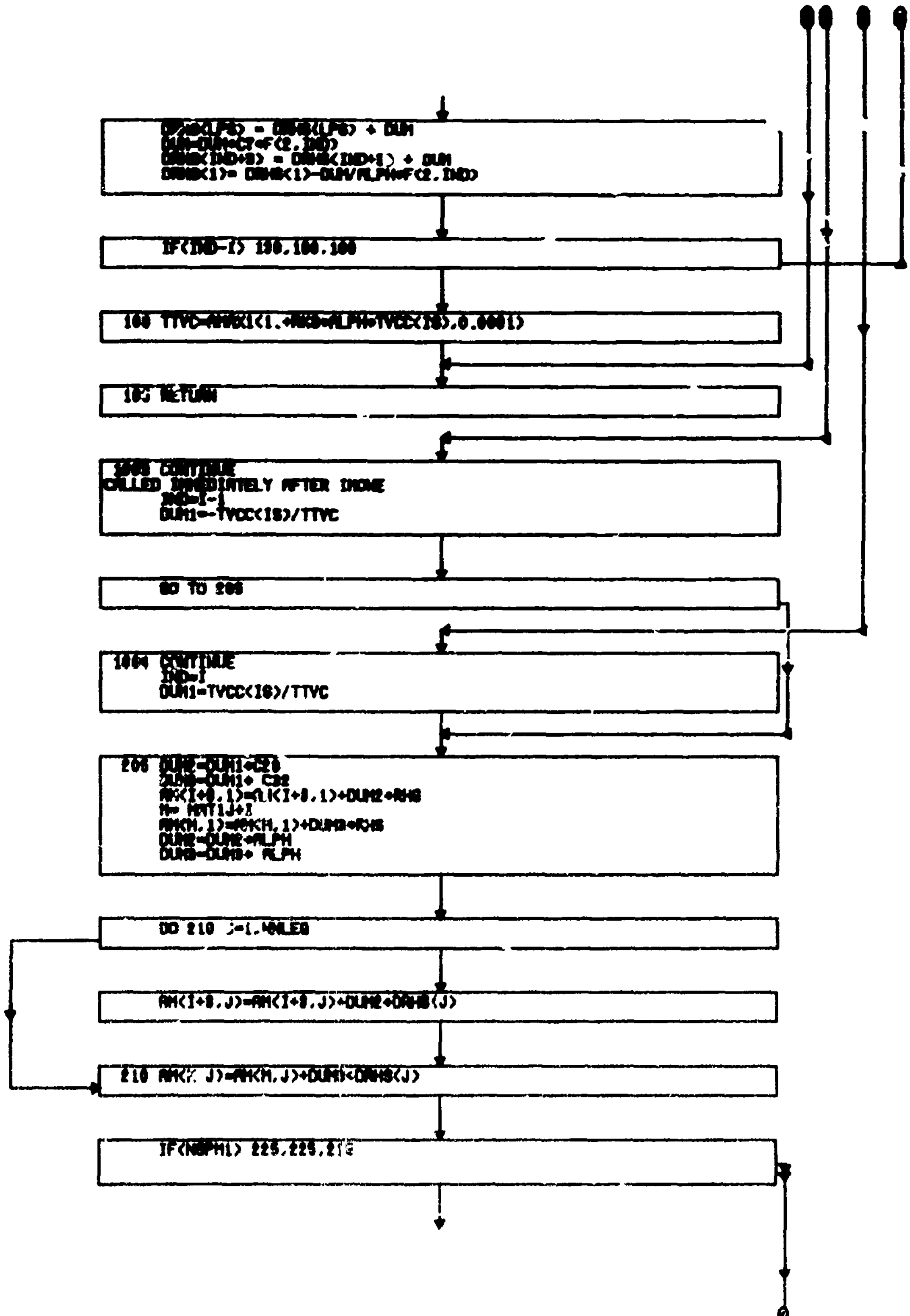
```
      AM(I+3,1)=AM(I+3,1)+DUM2*RHS
      M= MAT1J+I
      AM(M,1)=AM(M,1)+DUM3*RHS
      DUM2=DUM2*ALPH
      DUM3=DUM3* ALPH
      DO 210 J=1,NNLEQ
      AM(I+3,J)=AM(I+3,J)+DUM2*DRHS(J)
  210 AM(M,J)=AM(M,J)+DUM3*DRHS(J)
      IF(NSPM1) 225,225,215
  215 DO 220 K=1,NSPM1
      DUM3=DUM1*CK6(K)
      M=M+MAT2J
      AM(M,1)=AM(M,1)+DUM3*RHS
      DUM3=DUM3*ALPH
      DO 220 J=1,NNLEQ
  220 AM(M,J) = AM(M,J) + DUM3*DRHS(J)
  225 RETURN
      END
```

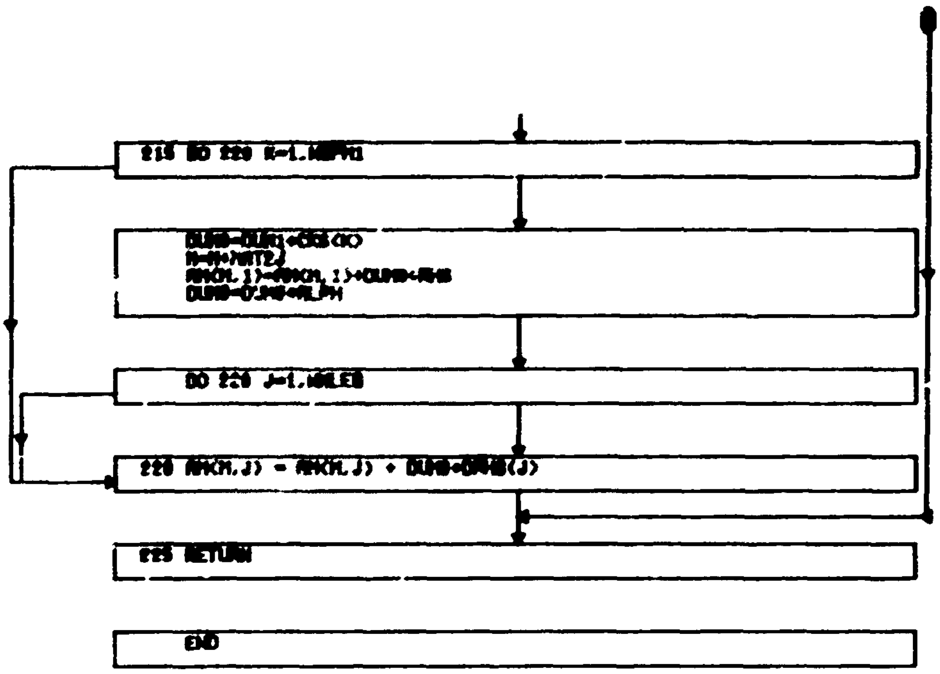
c. Flow Chart


CB:ST
SUBROUTINE TRANKR(IGO)
GO TO (1001,1002,1003,1004), IGO
1001 LOW=1
IF(KR(6)) 20,20,35
20 LIM= NSD(1)
DO 25 IS=2,LIM
SDUM1(IS) = S(IS) * S(IS)
25 SDUM2(IS) = 1.-RCKAP(IS)/S(IS)
SDUM1(1)=0.
SDUM2(1)=0.
CALL SLOPQ(LIM, SDUM1, SDUM2, DER, DER)
DO 30 IS=2,LIM
DUM=1. - SDUM2(IS)
30 TVCC(IS) = SQRT(4.*DER(IS)*(DUM-SDUM1(IS)*DER(IS))+ SDUM2(IS)/SDUM
11(IS)*(1.+DUM))/DUM
TVCC(1) = SQRT(8.*DER(1))
LOW=2
IL=1
IF(NDISC) 50,50,40


35 IL=0
40 LIM=NDISC+1
DO 45 II=LOW.LIM
M=NSD(II)
CALL SLOPG(NSD(II), S(M), ROKAP(M), DER(M), DER(M))
MM=M+IL
IL=1
IGH=M+NSD(II)-1
DO 45 IS=MM.IGH
45 TVCC(IS) = SQRT(1.-DER(IS)*DER(IS))/ROKAP(IS)
50 DO 55 IS=1,IS
55 TVCC(IS)=-TVCC(IS)*2.*CSM(IS)+VMUE(IS)
RETURN
1001 CONTINUE
CALLED IMMEDIATELY AFTER ICOEFF
IF(I-1) 115 115,125
115 RHS=0.
DO 120 J=1.NNLEQ
120 DRHS(J)=0.


GO TO 130
125 IND=I-1
SIX=-6.
GO TO 140
130 IND=I
SIX=6.
C27=DRHOH
DO 135 K=1,NSPM1
135 CK11(K)=DRHOK(K)
IF(I-1) 165,165,140
140 DUM=DETA(I-1)/2. *RHOE(IS)/RHO(IND)
IF(KB(3).LT.0) DUM=-DUM
RHS=RHS+DUM*(1.+RHOP(IND)/RHO(IND)*DETA(I-1)/SIX)
DUM=-DUM/RHO(IND)
LPS=MAT1J+IND+1
IF(NSPM1) 155,155,145
145 LPI=LPS
DO 150 K=1,NSPM1
LPI=LPI+MAT2J
150 DRHS(LPI)=DRHS(LPI)+DUM*CK11(K)
155 DUM=DUM*C27


IF(IND-I) 100,100,100
RETURN
CONTINUE
CALLED IMMEDIATELY AFTER INONE
DUM1=-TVCC(IS)/TTVC
GO TO 200
CONTINUE
DUM1=TVCC(IS)/TTVC
DO 210
IF(NSPM1) 225,225,215


RETURN
END

21. SUBROUTINE EQUIL (KQ, Z, PRR) - B20A

a. Function

Control program for computation of chemical state of the system. Performs such complex functions as setting up for different types of solutions (isentropic expansion, stagnation point, boundary layer or wall), recalling stored values of boundary layer solutions and reinitializing omitted species, reevaluating absent atom array, deleting molecules based on absent atom array, and, with the aid of subroutines, evaluating properties, controlling principal iterative loop, and reinverting and attempting alternate paths when convergence problems occur. Called by NONCER, REFCON. Calls CRECT, MATER, PROPS, RERAY, THERM, DUMCOM.

KQ = Flag which controls chemistry options (see Fortran variables list)

Z = Enthalpy (when used)

PRR = Pressure

b. Listing

```
      CB20A                                                              B20A 001
            SUBROUTINE EQUIL(KQ,Z,PRQ)                                   B20A 002
            INTEGER FAMOA,FAMOB                                          B20A 004
            EQUIVALENCE(TU( 72),TF),(VNU,CIJ)                            B20A 006
            DIMENSION CIJ( 71,1),TF(1)                                   B20A 007
            DIMENSION APE(16,16),BS(16)                                  B20A 008
            DIMENSION VLAM( 71,1),  X(14),GAMK( 71,1),KQ(10),DQJRNL( 71,1)  B20A 009
            EQUIVALENCE(AM( 74),DQJRNL( 74),GAMK,VLAM)                   B20A 010
            COMMON /BLQCOM/FAMOA( 71),FAMOB( 71),N    ,FR( 71,15),W(3),LEF(10)B20A  11
           1,LEFS(10),PIEASE,LEFW(10)                                    B20A  12
            COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IXB20A  13
            COMMON/EDGCOM/                PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B20A  14
           1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90   B20A  15
           2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                               B20A  16
            COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B20A  17
           1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B20A  18
           2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),   B20A  19
           3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),Y( 71),YW( 71),GG( 71)  B20A  20
           4 ,TQ(10, 7),EPOVRK,SIGMA,BASMOL                              B20A  21
            COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,   B20A  22
           1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPQ,   B20A  23
           2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HG,  B20A  24
           3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),  B20A  25
           4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),BLAM(10),DY( 71),RVS,  B20A  26
           5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),   B20A  27
           6 RC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)                B20A  28
            COMMON/FLPCOM/TXI(2),TUE(2),TRHOE(2),TTE(2),TVMUE(2),TMAT(566,2)  B20A  29
           2,THF(15,2),LEFT(10,2),TPE(2),TRADS(2),TDSIP(2),KQT(2)        B20A  30
            COMMON/FLXCOM/DELQW,DELJW( 8),DQNL(153),DJNL(153, 8),WALLQ   B20A  31
           1,WALLJ( 8),QW,VJKW( 9),TPWALL                                B20A  32
            COMMON /INTCOM/KKR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,II,  B20A  33
           1ISS,NS,ITT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL,MITS,KAPPA,CBAR,   B20A  34
           2CASE(15),BB(8),  MWE,NON,KD(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,   B20A  35
           3 KR9(40),KAUXO,JTIME,JSPEC,MD(3)                             B20A  36
            COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                     B20A  37
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)          B20A  38
            COMMON /PRPCOM/PR(15),TT(15),RHO(15),SC(15),CAPC(15),QR(15),HH(15)B20A  39
           1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB20A  40
           2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B20A  41
           3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)  B20A  42
           4,DPHIKK( 8, 8),      DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL   B20A  43
           5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B20A  44
           6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B20A  45
            COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH               B20A  46
            COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)     B20A  47
           1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ  B20A  48
            EQUIVALENCE(B,X)                                             B20A 046
          1 FORMAT(10I1,3F10.5)                                          B20A 047
          2 FORMAT(/9X6HTEMP =F10.4,17H DEG-K     PRES =F8.4,17H ATM     MOL WB20A 048
           1T =F11.7)                                                    B20A 049
          3 FORMAT( /87H  SPECIES  PAR.PRES.      D-LOG-PP      LOG-PP      LOB20A 050
           1G-KP     FLAG   ERROR            CP  /(1X2A4,4E13.5,I5,2E13.5))   B20A 051
          4 FORMAT(/10X60H CP-FROZEN    CP-EQUIL   DLNM/DLNT    DLNM/DLNP    GB20A 052
           1AMMA         /10X5E12.5)                                     B20A 053
          7 FORMAT(I3,F8.2,11E10.3/91X3E10.3)
          8 FORMAT(10X10HENTHALPY =E14.7,20H CAL/GM    ENTROPY =E12.5,13H CAL/B20A 055
           1GM-DEG K/10X 9HDENSITY =E13.6, 8H LB/CUFT)                   B20A 056
          6 FORMAT(//)                                                   B20A 057
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    9 FORMAT(5X 5HVEL =E10.3,16H FT/SEC   MACH =E10.3,  9H   AREA =E10.3B20A 058
     1,12H SQFT/LB/SEC)                                                B20A 059
   10 FORMAT(10X17HFRACTION LIQUID =F8.5)                              B20A 060
   42 FORMAT(8F10.4)                                                   B20A 061
      DTU=500.
      DTD=DTU
      LEFUP=1                                                          B20A 063
      TTMIN=250.                                                       B20A 064
      TTMAX=20000.
      ITS=0                                                            B20A 065
      IG=0
      INV=0
      SPEASE=PIEASE
      TION=1500.
      ISP=IS+1                                                         B20A 066
      DO 302 I=1,6
  302 KR(I)=KQ(I)                                                      B20A 068
      MODE=KR(1)                                                       B20A 069
      P=PRR                                                            B20A 070
      KR(8)=0
      KR(6)=KR(6)-1                                                    B20A 071
      IF(KKR(18)-6) 3021,3021,3022
 3021 KR(7)=KKR(18)*5-9
      N7=51-KKR(18)*5
      GO TO 3023
 3022 KR(7)=0
      N7=KKR(18)*10-50
 3023 IF(KR(5)-1) 310,304,306
C*****ISENTROPIC EXPANSION                                             B20A 074
  304 SIP=SIP-DSIP(ISS)                                                B20A 075
      IEW=2                                                            B20A 076
      II=NETA                                                          B20A 077
      GO TO 324                                                        B20A 078
C*****STAGNATION POINT AND INITIAL...ION                               B20A 079
  306 IEW=2                                                            B20A 080
      KR(8)=0
      ITFF=0
      PIEASE=0.
      KQ(6)=0                                                          B20A 081
      HIP=Z/1.8                                                        B20A 082
      MITS=1                                                           B20A 083
      II=NETA                                                          B20A 084
      T=3000.                                                          B20A 085
      WM=20.                                                           B20A 086
      AA=P*WM                                                          B20A 087
      DO 309 I=1,IS
  309 ALP(I)=TQ(I,1)                                                   B20A 089
      KR(6)=-1                                                         B20A 090
      IF(ITEM-1) 350,308,350
  308 IF(KKR(2)-2) 311,350,311
  310 IF(KR(6)) 312,330,330                                            B20A 092
  311 LEFUP = -1
      IF (KKR(12)-1) 384,350,384
C*****BOUNDARY LAYER                                                   B20A 093
  312 ALP(IS)=0.                                                       B20A 094
      LEFUP=MITS+II-2
      HIP=Z/1.8                                                        B20A 096
      ALP(NSP)=1.0                                                     B20A 097
      IF(NSPM1) 3141,3141,313
  313 DO 314 K=1,NSPM1
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```
      ALP(K)=SP(1,II,K)/WTM(K)                                          B20A 099
  314 ALP(NSP)=ALP(NSP)-SP(1,II,K)                                      B20A 100
 3141 ALP(NSP)=ALP(NSP)/WTM(NSP)
      DO 319 I=1,NSP                                                    B20A 102
      ARPH=0.                                                           B20A 103
      ARPHM=0.                                                          B20A 104
      DO 315 K=1,NSP                                                    B20A 105
      DUM=CIJ(I,K)*ALP(K)                                               B20A 106
      ARPHM=AMAX1(ARPHM,ABS(DUM))                                       B20A 107
  315 ARPH=ARPH+DUM                                                     B20A 108
      IF(II.EQ.1.AND.LEFW(I).EQ.1) LEF(I)=1                                  *NEW
      IF(ARPH-.0001*ARPHM) 316,316,319
  316 IF(II.EQ.1.AND.LEF(I).EQ.1) LFF(I)=0
      LEF(I)=-IABS(LEF(I))
      LEFS(I)=-IABS(LEFS(I))
  319 CONTINUE                                                          B20A 111
  320 IF(ITFF) 326,350,350                                              B20A 112
C*****ACCEPT RESIDENT VALUES AS FIRST GUESSES                           B20A 113
  324 IF(T-TION) 328,398,398
  326 ITFF=ITFF+1                                                       B20A 115
      IF(II-1) 323,323,322
  322 II=1
      GO TO 350
 323  IF (ITFF) 327,329,329
  327 IF(KR2-1) 328,329,328
  329 GO TO 350
  328 LFF(NSP+1)=-IABS(LEF(NSP+1))                                      B20A 116
      IF(LEFUP) 393,364,393
C*****WALL SOLUTION                                                     B20A 118
  330 IFW=1                                                             B20A 119
      ITFF=-1                                                           B20A 120
      II=1                                                              B20A 122
      CHFLUX=W(3)
      PIEASE=PIEASE*0.989*(1.0-FASE)
      KR(7)=MAX0(KR(7),KKR(16)*5-.)
      IF(TT(1)/1.8.GT.TF(N+1)) KR(8)=1
      IF(MODE-1) 333,331,333                                            B20A 123
  331 TTMIN=TT(1)/1.8-500.
      TTMAX=TT(1)/1.8+500.
      KR(8)=0
  333 IF(KR(8).EQ.1) CHFLUX=-1.
      DO 332 K=1,IS
      IF(LEF(K)) 332,3331,332
 3331 IF(W(2)*TK(K,L2)+CHFLUX*TK(K,L3).LT.0.) LEF(K)=1
  332 ALP(K)=TQ(K,L2)*AMIN1(0.,W(2))+TQ(K,L3)*AMIN1(0.,W(3))+TQ(K,1)*
     1 AMIN1(0.,W(1))
      WS=-W(1)-W(2)-W(3)
      WSS=-AMIN1(0.,W(1))-AMIN1(0.,W(2))-AMIN1(0.,W(3))
      DO 335  L=NSP,IS                                                  B20A 129
      DO 334 K=1,IS                                                     B20A 130
      GAMK(K,L)=0.                                                      B20A 131
  334 GAMK (L,K)=0.                                                     B20A 132
      GAMH(L)=0.                                                        B20A 133
  335 GAMF(L)=0.                                                        B20A 134
      IF(NSPM1) 3361,3361,3351
 3351 DO 336 K=2,NSP
      GAMH(NSP)=GAMH(NSP)-DQJRNL(2,K)/WTM(NSP)*1.8                      B20A 136
      GAMF(NSP)=GAMF(NSP)-DQJRNL(1,K)/WTM(NSP)                          B20A 137
      ALP(NSP)=ALP(NSP)+WALLJ(K-1)/WTM(NSP)                             B20A 138
      ALP(K-1)=ALP(K-1)-WALLJ(K-1)/WTM(K-1)                             B20A 139
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      GAMH(K-1)=DQJRNL(2,K)/WTM(K-1)*1.8                               B20A 140
      GAMF(K-1)=DQJRNL(1,K)/WTM(K-1)                                   B20A 141
      DO 336 KK=2,NSP                                                  B20A 142
  336 GAMK(KK-1,NSP)=GAMK(KK-1,NSP)-GAMK(KK-1,K-1)                     B20A 143
 3361 DO 3362 K=1,IS
      DO 3362 J=ISP,N
 3362 VLAM(J,K)=WS*WTM(J)*GAMF(K)
      DUM1=NSPM1                                                       B20A 144
      DO 340 K=1,NSP                                                   B20A 145
      GAMH(K)=-GAMH(K)
      SUMG=0.                                                          B20A 146
      IF(NSPM1) 3392,3392,3391
 3391 DO 339 KK=1,NSP
      IF(KK-K) 337,339,337                                             B20A 148
  337 SUMG=SUMG+GAMK(KK,K)                                             B20A 149
  339 CONTINUE                                                         B20A 150
      SUMG=SUMG/DUM1                                                   B20A 151
      ALP(K)=-ALP(K)+SUMG/WTM(K)
 3392 DO 338 KK=1,NSP
  338 GAMK(KK,K)=-(GAMK(KK,K)-SUMG)/WTM(K)*WTM(KK)
      DO 340 KK=1,NSP                                                  B20A 157
      DO 3401 J=ISP,N
 3401 VLAM(J,K)=VLAM(J,K)+GAMK(KK,K)*VNU(J,KK)
  340 GAMK(KK,K)=GAMK(KK,K)+WTM(KK)*GAMF(K)*WS
C******RECALL STORED VALUES OF BOUNDARY LAYER SOLUTION AND              B20A 159
C     RE-INITIALIZED OMITTED SPECIES                                   B20A 160
  350 II=II-IG
      PIN=1.E-4*P
      PINL=ALOG(PIN)
      LIM=N+KR(8)
      DO 354 I=1,LIM
      IF(IFC(I)-1) 342,342,341                                         B20A 165
  341 IFC(I)=IFC(I)-3                                                  B20A 166
      GO TO 345                                                        B20A 167
  342 IF(IFC(I)+1) 343,345,345                                         B20A 168
  343 IFC(I)=IFC(I)+3                                                  B20A 169
  345 IF (IFC(I)) 346,349,346                                          B20A 170
  346 VN(I)=FR(I,II)*P
      IFC(I)=1                                                         B20A 172
      Y(I)=0.                                                          B20A 173
      IF(VN(I)) 347,347,354                                            B20A 175
  347 IFC(I)=-1                                                        B20A 176
      IF (I-IS) 348,348,354                                            B20A 177
  348 Y(J)=PINL                                                        B20A 178
      GO TO 3530
  349 IF(FR(I,II))357,357,352                                          B20A 180
  357 IF(VN(I)) 351,351,358
  358 IF(II-1) 353,351,353
  351 VN(I)=PIN                                                        B20A 183
      GO TO 353                                                        B20A 184
  352 VN(I)=FR(I,II)*P
  353 Y(I)=ALOG(VN(I)+1.E-35)
 3530 IF(II-1) 354,3531,354
 3531 IF(IS-I) 354,3532,3532
 3532 Y(I)=YW(I)
      IF(FR(I,1)-1.E-30) 354,3533,354
 3533 VN(I)=EXP(Y(I))
  354 CONTINUE                                                         B20A 187
      T=TT(II)/1.8                                                     B20A 188
      IF(T-TION) 355,356,356
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  355 LEF (NSP+1)=-IABS(LEF(NSP+1))                                      B20A 190
  356 WM=VMW(II)
      II=II+IG
      IF(LEFUP) 384,364,393
C*****REEVALUATE ABSENT ATOM ARRAY                                       B20A 193
  364 JT=MOD(ITEM,2)+1
      DO 382 K=1,NSP                                                     B20A 196
      LEFW(K)=0                                                              *NEW
      LEFS(K)=LEF(K)
      LEF(K)=ISIGN(LEFT(K,JT),LEF(K))
      IF(LEF(K)-2) 369,365,382                                           B20A 198
  365 IF(ISS-2) 369,366,367
  366 IF(KKR(6)-1) 369,369,367
  367 IF(KKR(3,) 369,369,382
  369 LEF(K)=MIN0(LEF(K),0)                                              B20A 200
      IF(KKR(9)-2) 370,382,381                                               *NEW
  370 DUM1=1.0                                                           B20A 202**-i
      DUM2=0.                                                            B20A 203
      IF(NSPM1) 3721,3721,3701
 3701 DO 372 J=1,NSPM1
      DUM1=DUM1-SPW(J,ISS,ITT)                                           B20A 205
  372 DUM2=DUM2+SPW(J,ISS,ITT)*CIJ(K,J)                                  B20A 206
 3721 IF(ABS(DUM1)-1.E-7) 376,374,374
  374 DUM2=DUM2+DUM1*CIJ(K,NSP)                                          B20A 209
  376 IF(DUM2) 382,382,380                                               B20A 209
  380 LEF(K)=1
      GO TO 382                                                              *NEW
  381 IF(W(2)*TK(K,L2)+W(3)*TK(K,L3).LT.0.) LEFW(K)=1                        *NEW
  382 CONTINUE                                                           B20A 212
      GO TO 393                                                          B20A 213
C*****INITIALIZE SP(,,) AND VN() ON FIRST STAGNATION SOLUTION             B20A 214
  384 ITFF=-NETA                                                         B20A 215
      NCV=0                                                              B20A 216
      TT(1)=3000.
      VMW(1)=20.
      KR2=KKR(2)
      IF(KR2.LT.0) KR2=1
      IF(KR2.EQ.1) GO TO 387
  385 DO 386 K=1,NSP
      DO 386 I=1,NETA                                                    B20A 220
      SP(1,I,K)=ALP(K)*WTM(K)                                            B20A 221
      SP(2,I,K)=0.                                                       B20A 222
  386 SP(3,I,K)=0.                                                       B20A 223
      W(1)=0.
      W(2)=0.
      W(3)=0.
      LEF(IS)=3                                                          B20A 224
      LEFS(IS)=3
      DO 3868 I=1,NSP                                                    B20A 225
      LEF(I)=0                                                           B20A 226
      IF(TK(I,1)) 3868,3868,3867                                         B20A 227
 3867 LEF(I)=3                                                           B20A 228
 3868 CONTINUE                                                           B20A 229
  387 DO 388 I=1,IS                                                      B20A 230
      IF(ALP(I)) 393,388,388                                             B20A 231
  388 CONTINUE                                                           B20A 232
      DO 3881 I=1,NETA
      DO 3881 J=1,N
 3881 FR(J,I)=0.
      DO 392 I=1,IS                                                      B20A 233
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      VN(I)=AMAX1(VN(I)/P*.1,ALP(I)*AA)                                 B20A 234
      IF(IFC(I)) 390,391,390                                            B20A 235
  390 IFC(I)=1                                                          B20A 236
      Y(I)=0.                                                           B20A 237
      GO TO 392                                                         B20A 238
  391 Y(I)=ALOG(VN(I))                                                  B20A 239
  392 CONTINUE                                                          B20A 240
C*****DELETE MOLECULES BASED ON ABSENT ATOM ARRAY                       B20A 241
  393 LAMD=1
      DO 3971 K=1,IS                                                        *NEW
      IF(LEF(K)) 394,3930,3934                                              **-1
 3934 IF(PIEASE-.99) 3931,3931,3933
 3930 IF(PIEASE-.01) 394,394,3933
 3933 IF(LEFS(K)) 3932,394,3931                                             *NEW
 3931 IF(II-NETA) 397,3932,397                                      B20A 244**-1
 3932 IF(LEF(K)-3) 394,397,394                                      B20A 245**-1
  394 DO 396 J=1,N                                                  B20A 246
      IF(IABS(IFC(J))-1) 389,389,396                                B20A 247
  389 IF(MOD(LAMI(J)/LAMD,2)) 395,396,395
  395 VN(J)=0.
      IFC(J)=IFC(J)-3                                               B20A 250
  396 CONTINUE                                                      B20A 251
      J=-IR(K)                                                      B20A 253**-1
      IF(IFC(J)-1) 3961,3961,397                                    B20A 254
 3961 IFC(J)=IFC(J)+6                                               B20A 255
  397 LAMD=LAMD+LAMD
      LEF(K)=IABS(LEF(K))                                                   *NEW
 3971 LEFS(K)=IABS(LEFS(K))                                                 *NEW
C*****DELETE CONDENSED SPECIES FROM BOUNDARY LAYER
      IF(KR(6)) 3980,398,398
 3980 DO 3984 J=1,N
      IF(IABS(IFC(J))-1) 3984,3981,3984
 3981 IFC(J)=IFC(J)-3
      VN(J)=0.
 3984 CONTINUE
  398 IF(KR(7)-1) 21,21,1902                                        B20A 258
C*****EVALUATE PROPERTIES                                           B20A 259
  170 CPF=CPF/AA
      IF(KR(6)) 1701,1932,1702
 1702 HG=0.
      HL=0.
      WTL=0.
      RV=RVS+(RV-RVS)/EASE
      DO 1703 J=1,N
      IF(IFC(J)) 1703,1704,1705
 1704 HG=HG+VN(J)*H(J)
      GO TO 1703
 1705 HL=HL+VN(J)*H(J)
      WTL=WTL+VN(J)*WTM(J)
 1703 CONTINUE
      HIP=(HG+(HL-WTL/AA*HG)/WS)/AA
      GO TO 1932
 1701 IN=IS+2
      IG=MIN0(IQQ,-KKR(20))
      CALL RERAY(IN,A,0,B,0,0,IG,16)                                B20A 263
      ALF=A(2,1)/A(1,1)                                             B20A 265
      CSP=1./(A(1,1)*AA)                                            B20A 266
      BETH=P*(A(2,2)-A(1,2)*ALF)-1.                                 B20A 267
      IF(MODE-3) 1931,1932,1931                                     B20A 268
 1931 CSP=CSP/T                                                     B20A 269
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 1932 CALL PROPS                                                          B20A 270
      WM=AA/P
      GAM=1.-ALF
      GAM=1./(1.+BETH-1.9869/AA*GAM/CSP*GAM*P)
      GMR(II)=GAM
      IF(KR(5))195,195,194                                                B20A 271
  195 IF(KR(7))  11,11,194                                                B20A 272
  194 WRITE (KOUT,4) CPF,CSP,ALF,BETK,GAM
      ITS=-1                                                              B20A 276
C*****OUTPUT PACKAGE                                                      B20A 277
   19 WM=AA/P                                                             B20A 278
 1902 WRITE(KOUT,  2)T,P,WM                                               B20A 279
      WRITE(KOUT,1901)W                                                   B20A 280
 1901 FORMAT(5X40HRELATIVE MASSES OF COMPONENTS 1,2 AND 3  3E12.5)        B20A 281
      SHIP=HIP                                                            B20A 282
      SSIP=SIP                                                            B20A 283
      HIP=0.                                                              B20A 284
      SIP=0.                                                              B20A 285
      DO 20 J=1,N                                                         B20A 286
      HIP=HIP+H(J)*SIGN(VN(J),WTM(J))
   20 SIP=SIP+ VN(J)*(SR(J)-1.9869*Y(J))                                  B20A 288
      N=N+KR(8)
      HIP=(HIP+VN(MELT)*FLIQ*HMELT)/AA                                    B20A 289
      SIP=(SIP+VN(MELT)*FLIQ*SMELT)/AA                                    B20A 290
      RHR=P/T*WM/1.3146                                                   B20A 291
      WRITE(KOUT,8) HIP,SIP,RHR                                           B20A 292
      IF(FLIQ) 204,205,204                                                B20A 293
  204 WRITE(KOUT,10) FLIQ                                                 B20A 294
  205 IF(ITS) 2051,203,203                                                B20A 295
 2051 IF(KR(5)-1) 203,202,201                                             B20A 296
  201 HCH=HIP                                                             B20A 297
  202 VELSQ=(HCH-HIP)*2.                                                  B20A 298
      VMACH=SQRT(VELSQ/GAM*WM/(1.9869*T))                                 B20A 299
      VEL=SQRT(VELSQ*45054.)                                              B20A 300
      UE(ISS)=VEL                                                         B20A 301
      IF (VEL) 2021,2021,2022
 2021 AREA=0.
      GO TO 2023
 2022 AREA=1./(VEL*RHR)
 2023 WRITE(KOUT,9) VEL,VMACH,AREA
  203 IF(IQQ) 2036,1203,1203
 1203 IF(ITS) 2031,2036,2036                                              B20A 305
 2031 DO 2033 I=1,N                                                       B20A 306
 2033 VN(I)=VN(I)/P                                                       B20A 307
      WRITE(KOUT,2032)(FAMOA(I),FAMOB(I),VN(I),I=1,N)                     B20A 308
      DO 2035 I=1,N                                                       B20A 309
 2035 VN(I)=VN(I)*P                                                       B20A 310
      IF(MODE-1) 2034,2037,2034                                           B20A 311
 2037 WRITE(KOUT,2038)  FAMOA(JC),FAMOB(JC)                               B20A 312
 2038 FORMAT(22H   SURFACE SPECIES IS 2A4)                                B20A 313
 2032 FORMAT(/3(5X7HSPECIES3X8HMOLE FR.2X)/(5X2A4,E12.5,5X2A4,E12.5,5X2AB20A 314
     14,E12.5))                                                           B20A 315
      GO TO 2034                                                          B20A 316
 2036 WRITE(KOUT,3) (FAMOA(I),FAMOB(I),VN(I),DY(I),Y(I),VLNK(I),IPC(I),EB20A 317
     1(I),CP(I),I=1,N)                                                    B20A 318
 2034 WRITE(KOUT,3)                                                       B20A 320
      N=N-KR(8)
      IF(ITS) 11,1021,1021                                                B20A 321
 1021 HIP=SHIP                                                            B20A 322
      SIP=SSIP                                                            B20A 323
```
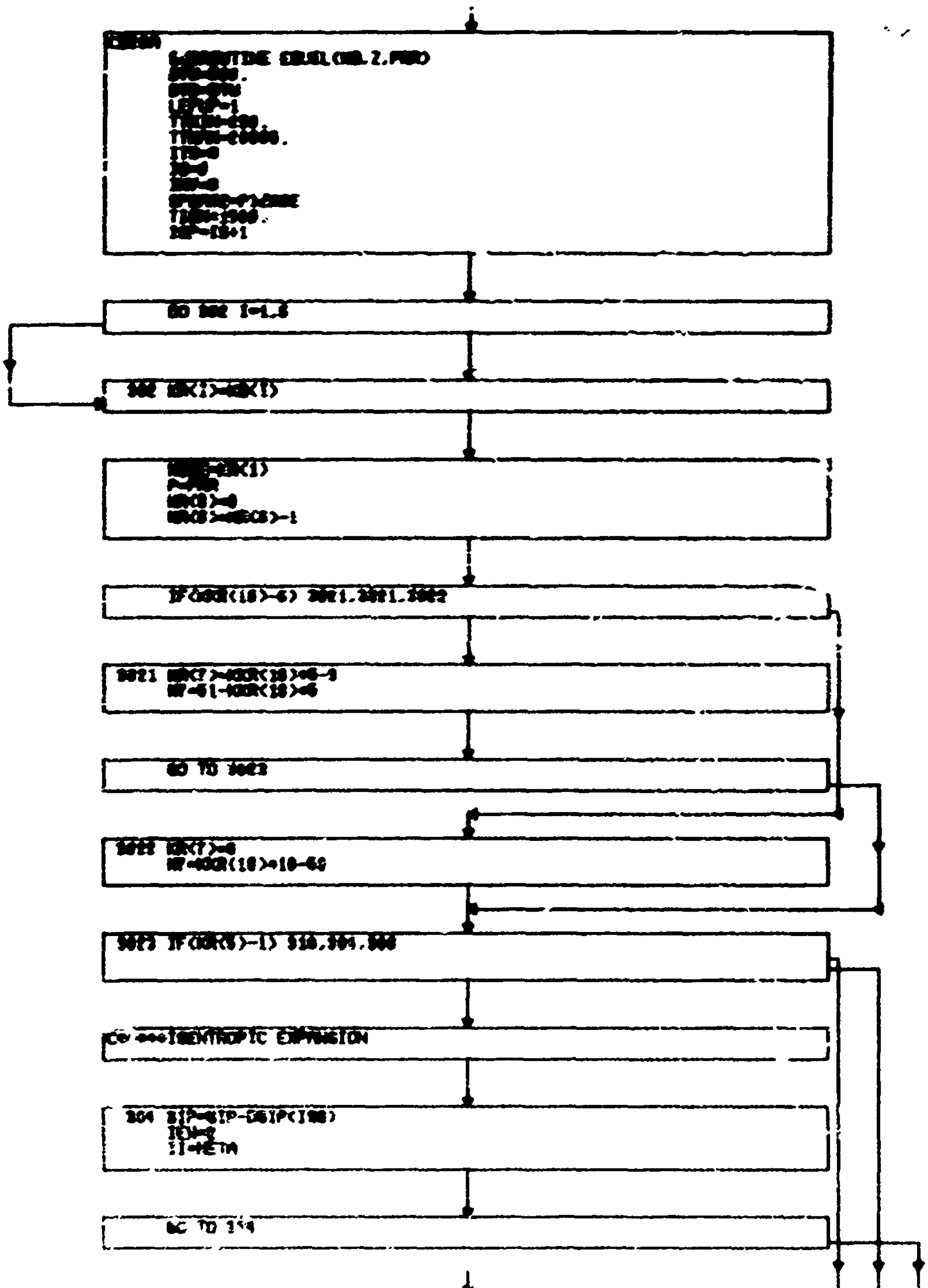
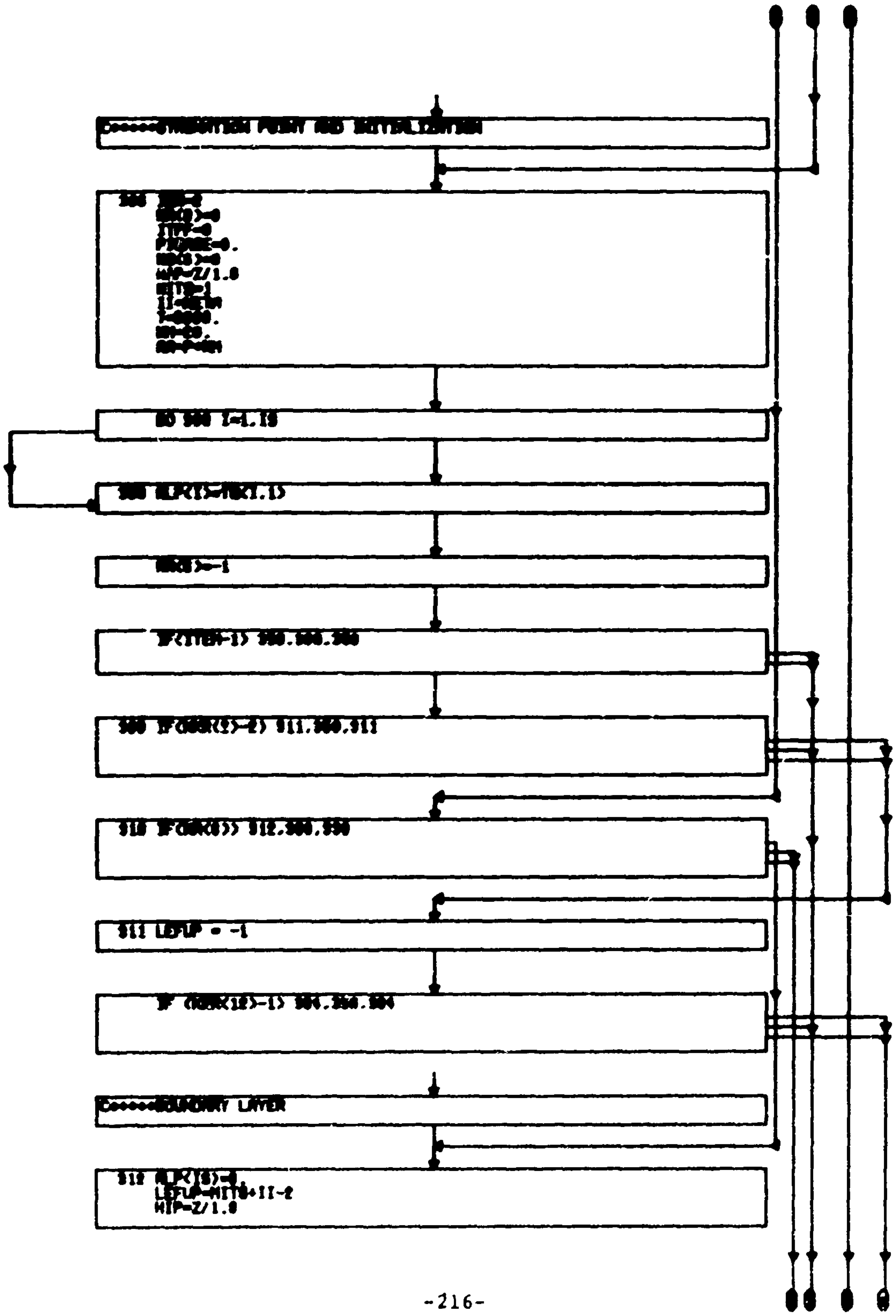

```
C*****PRINCIPAL ITERATIVE LOOP                                          B20A 324
   21 IF(ITS)  109,110,109                                              B20A 325
  109 IF(MODE) 111,111,110                                              B20A 326
 1091 ITS=ITS+1
  110 CALL THERM                                                        B20A 327
  111 MODE=KR(1)                                                        B20A 328
      IQG=0
      FLIQ=0.                                                           B20A 329
      CALL MATER                                                        B20A 331
      B1=B(1)                                                           B20A 332
  211 MOE=1                                                             B20A 333
      IF(KR(7)-1) 2101,210,2102                                         B20A 334
 2102 IQQ=-2                                                            B20A 335
      WRITE(KOUT,2100)(I,I-1,IS)
  210 WRITE(KOUT,7) ITS,T,AA,EL,ENL,CMF,(E(I),I=1,IS)
 2100 FORMAT (50H1ITS TEMP   PRES=MWT  EQUIL ER  MASBAL ER  SCALE  7(I3,
     17H MASBAL)/90X3(I3,7H MASBAL))
 2101 IF(ITS) 2103,221,221                                              B20A 337
 2103 IF(MODE-1) 170,2104,170                                           B20A 338
 2104 TWALG=T                                                           B20A 339
      GO TO 170                                                         B20A 340
  221 ITS=ITS+1                                                         B20A 341
      IF(ITS-50) 2219,2219,222
 2219 IF(ITS-N7) 22,2222,2222
  222 IF(KKR(18)) 2226,2226,2225
 2225 WRITE(KOUT,2000)
 2000 FORMAT (///2X,50H-----FOLLOWING OUTPUT NON-CONVERGENT--------------B20A 344
     1-/70H  ISS,ITEM,II,MITS,ITS,IQQ,KR(6),HIP,SIP,TT(II)/ALP(I)/LEF(I)
     2/FR(I,II))
      WRITE(KOUT,3017)ISS,ITEM,II,MITS,ITS,IG,KR(6),HIP,SIP,TT(II)
      WRITE(KOUT,3018) ALP
      WRITE(KOUT,3019) LEF
      WRITE(KOUT,3018) (FR(I,II),I=1,N)
 3017 FORMAT(7I5,2X1P3E12.5)
 3018 FORMAT(2X1P10E11.4)
 3019 FORMAT(2X10I5)
      IQQ=-2                                                            B20A 350
      KR(7)=1                                                           B20A 352
 2226 ITS=-1
      NCV=NCV+1                                                         B20A 353
      NON=NCV
      IF(NCV-20) 170,170,2220                                           B20A 354
 2220 MITS=100
      GO TO 170
 2222 KR(7)=3
      IQQ=-2
      GO TO 22
   22 ISPG=IN+IL-1                                                      B20A 356
      ICT=10
      DUM1=0.
      DO 2205 I=1,ISPG                                                  B20A 357
 2205 BS(I)=B(I)                                                        B20A 358
      GO TO 2208                                                        B20A 359
 2207 DO 2206I=IL,ISPG                                                  B20A 360
 2206 B(I)=BS(I)                                                        B20A 361
 2208 DO 2204 I=1,ISPG                                                  B20A 362
      DO 2200 J=1,ISPG                                                  B20A 363
 2200 APE(I,J)=A(I,J)                                                   B20A 364
      IF(I-2) 2204,2204,2201                                            B20A 365
 2201 IF(IFC(I-2)-1) 2204,2204,2202                                     B20A 366
```

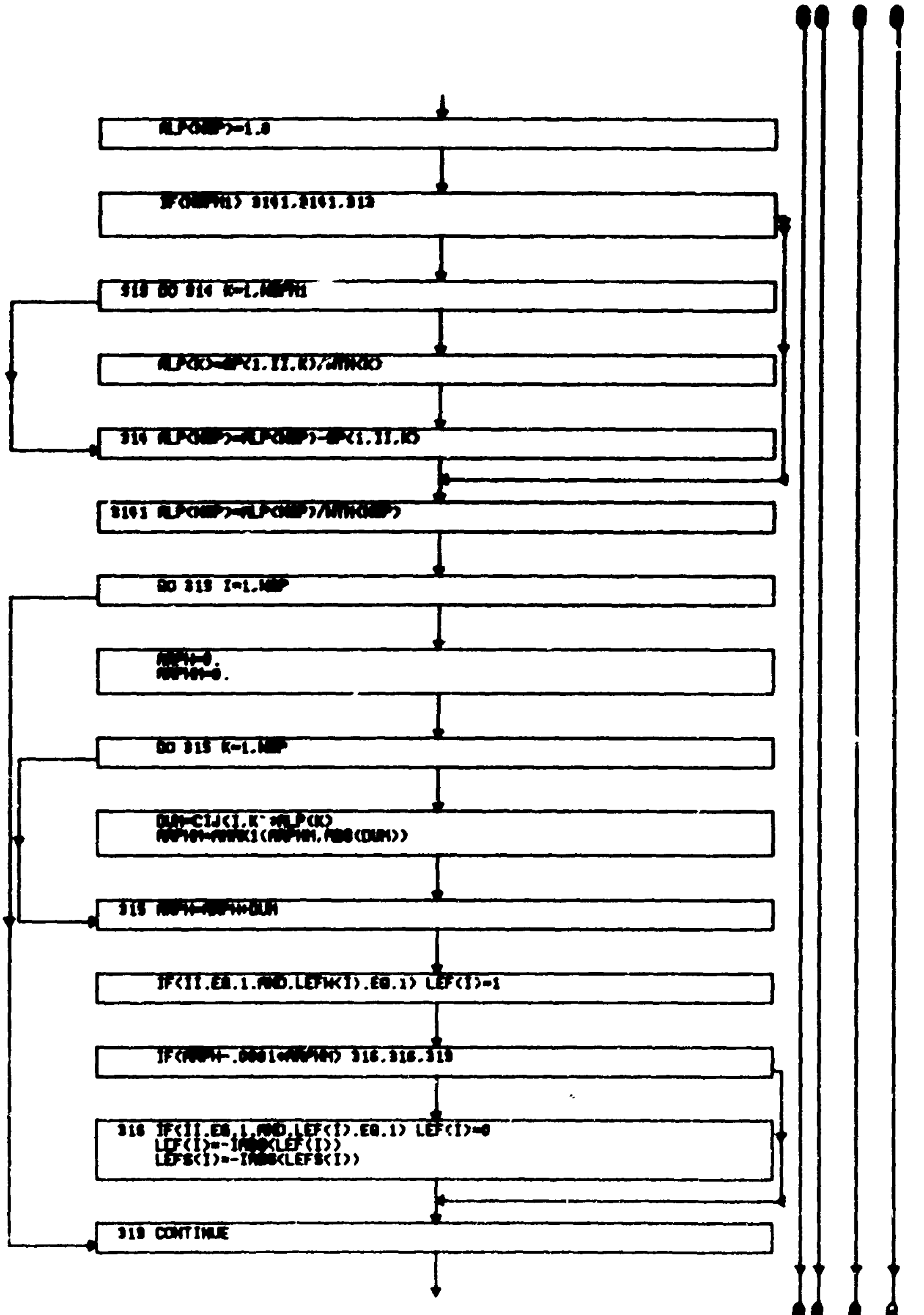
```
 2202 B(I)=0.                                                           B20A 367
      DO 2203 J=1,ISPG                                                  B20A 368
      APE(J,I)=0.
 2203 APE(I,J)=0.                                                       B20A 369
      APE(I,I)=1.0                                                      B20A 370
 2204 CONTINUE                                                          B20A 371
      IG=IQQ
      CALL RERAY(IN,APE(IL,IL),0,B(IL),1,0,IG,16)                       B20A 373
      ICT=ICT-1
      IF(ICT-IQQ) 222,2209,2210
 2209 IQQ=-2
 2210 IF(IG) 2212,2221,2221
 2212 IF(INV) 2216,2213,222
 2213 IF(KR(6)) 2227,2230,2230
 2230 LAMD=1
      DO 2229 K=1,IS
      J=-IR(K)
      IF(IFC(J).GT.1) GO TO 2229
      DO 2228 J=1,N
      IF(VN(J).GT.1.E-30 .AND. MOD(LAMI(J)/LAMD,2).NE.0) GO TO 2229
 2228 CONTINUE
      LEF(K)=-IABS(LEF(K))
      LEFW(K)=-IABS(LEFW(K))
      INV=-1
      ITS=1
      GO TO 393
 2229 LAMD=LAMD+LAMD
 2227 INV=-1
      PIN=P*1.E-5
      DO 2215 I=1,N
      IF(IFC(I)) 2215,2214,2215
 2214 VN(I)=VN(I)+PIN
      Y(I)=ALOG(VN(I))
 2215 CONTINUE
      GO TO 111
 2216 IF(KR(6)) 2217,222,222
 2217 ITS=999
      GO TO 111
C*****IF TRYING TO PUSH THROUGH TMIN OR TMAX -- REINVERT AND DT TO ZERO B20A 374
 2221 IF(T-TMIN) 2223,227,220
 2223 T=TMIN
      GO TO 1091
  227 IF (X(1)) 228,220,220
  220 IF (T-TMAX) 223,229,2224
 2224 T=TMAX
      GO TO 1091
  229 IF(X(1)) 223,223,228                                              B20A 378
C*****IF NEW CONDENSED HAS NEG CORRECTION, DELETE AFTER REINVERT       B20A 379
  223 IF(IER) 226,212,226                                               B20A 380
  226 IF(X(IER)+1.E-4) 225,212,212                                      B20A 381
  225 DO 2252 I=1,ISPG
      A(IER,I)=0.
 2252 A(I,IER)=0.
      BS(IER)=-1.E-8
      A(IER,IER)=1.0
      GO TO 2207                                                        B20A 384
C*****IF S.E. ERROR AND CORRECTION ON T OF CONFLICTING SIGN,REINVERT    B20A 385
  212 IF(MODE-1) 224,213,224                                            B20A 386
  213 IF(X(1)*B1+.00001) 228,218,218
C*****ON S.E. IF DELTA LN T .GT. .9 REINVERT NO DT IF EL AND ENL ARE SMAB20A 388
```

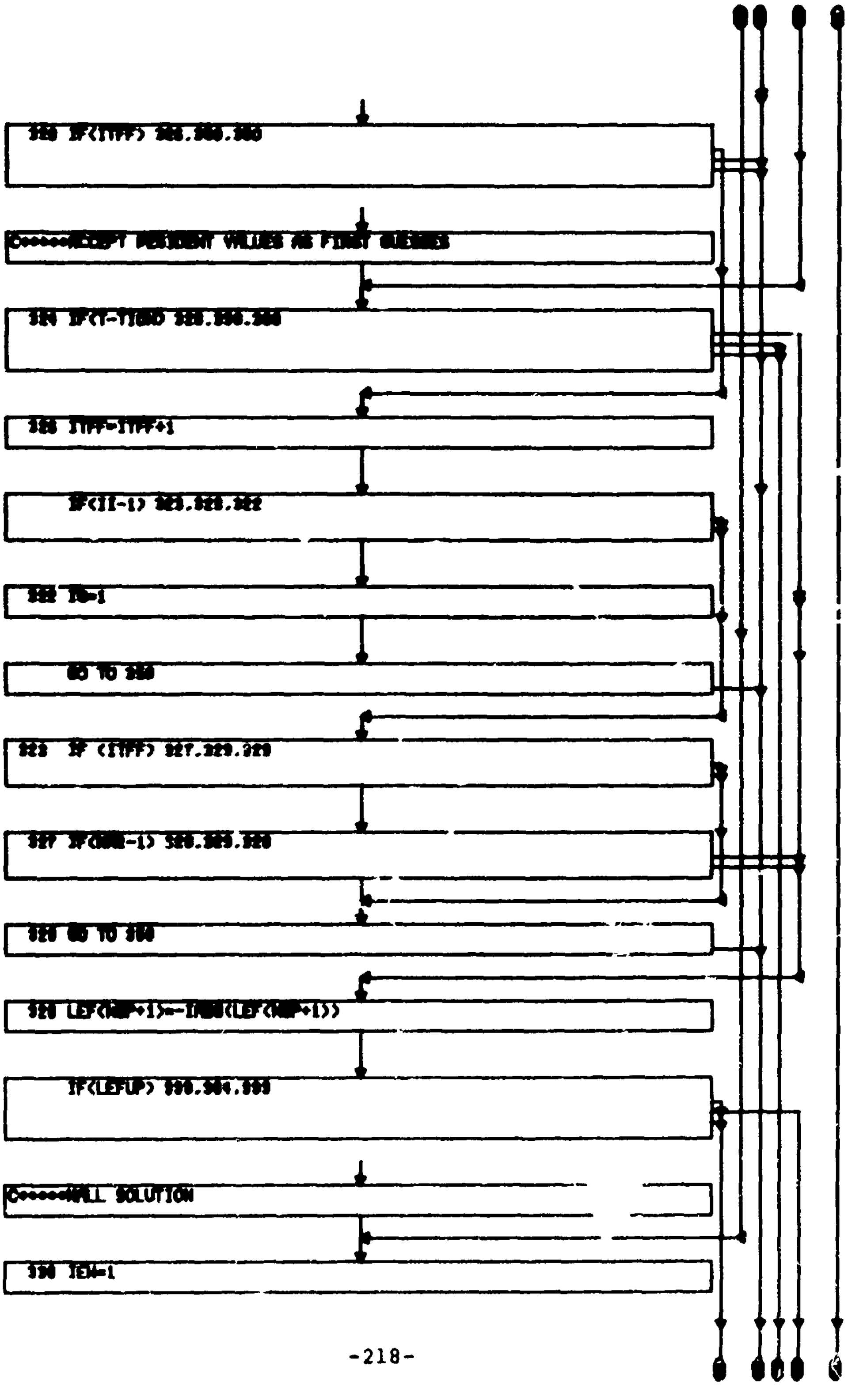
```
  210 IF(ABS(X(1))-0.9)224,224,220
C*****IF CONVERGED EXCEPT FOR T ON W OR S OPTIONS  --  NON CONVERGENT   B20A 393
  220 IF(MODE-1) 2281,214,2280                                          B20A 394
 2280 IF(EL+100.*ENL-1.E-4) 222,222,2281                                B20A 395
C*****ON S.E. OPTION RESULTIN IN CONFLICTING ERROR/CORRECTION OR T PUSH B20A 396
C*****IF OTHER BALANCES RELATIVELY GOOD, SET T TO TMIN/TMAX AS PER ERRORB20A 397
C*****AND GO TO THERM (IF T ALREADY THERE - NONCONVERSE) ELSE DT TO ZEROB20A 398
  214 IF(ABS(B1)-100.*(EL+ENL)) 2281,215,215                            B20A 399
  215 TTMIN=TT(1)/1.8-900.
      TTMAX=TTMIN+1000.
      IF(B1) 216,216,217
  216 IF(T-TMIN) 170,170,2161                                           B20A 401
 2161 T=AMAX1(T-DTD,TMIN)
      TTMAX=T
      DTU=DTD/2.
      GO TO 1091
  217 IF(T-TMAX) 2171,170,170
 2171 T=AMIN1(TMAX,T+DTU)
      TTMIN=T
      DTD=DTU/2.
      GO TO 1091
 2281 X(1)=0.                                                           B20A 407
      MODE=0                                                            B20A 408
      IN=IN-1                                                           B20A 411
      IL=2                                                              B20A 412
      GO TO 2207                                                        B20A 413
  224 IF(X(2)+1.0)2240,2249,2249
 2240 BS(2)=0.
      A(2,2)=1.E25
      GO TO 2207
 2249 CALL CRECT(MOE)
      TMIN=TTMIN
      TMAX=TTMAX
      IF(KR(7)-1) 21,21,19                                              B20A 415
   11 PIEASE=SPEASE
      RETURN
      END                                                               B20A 417
```

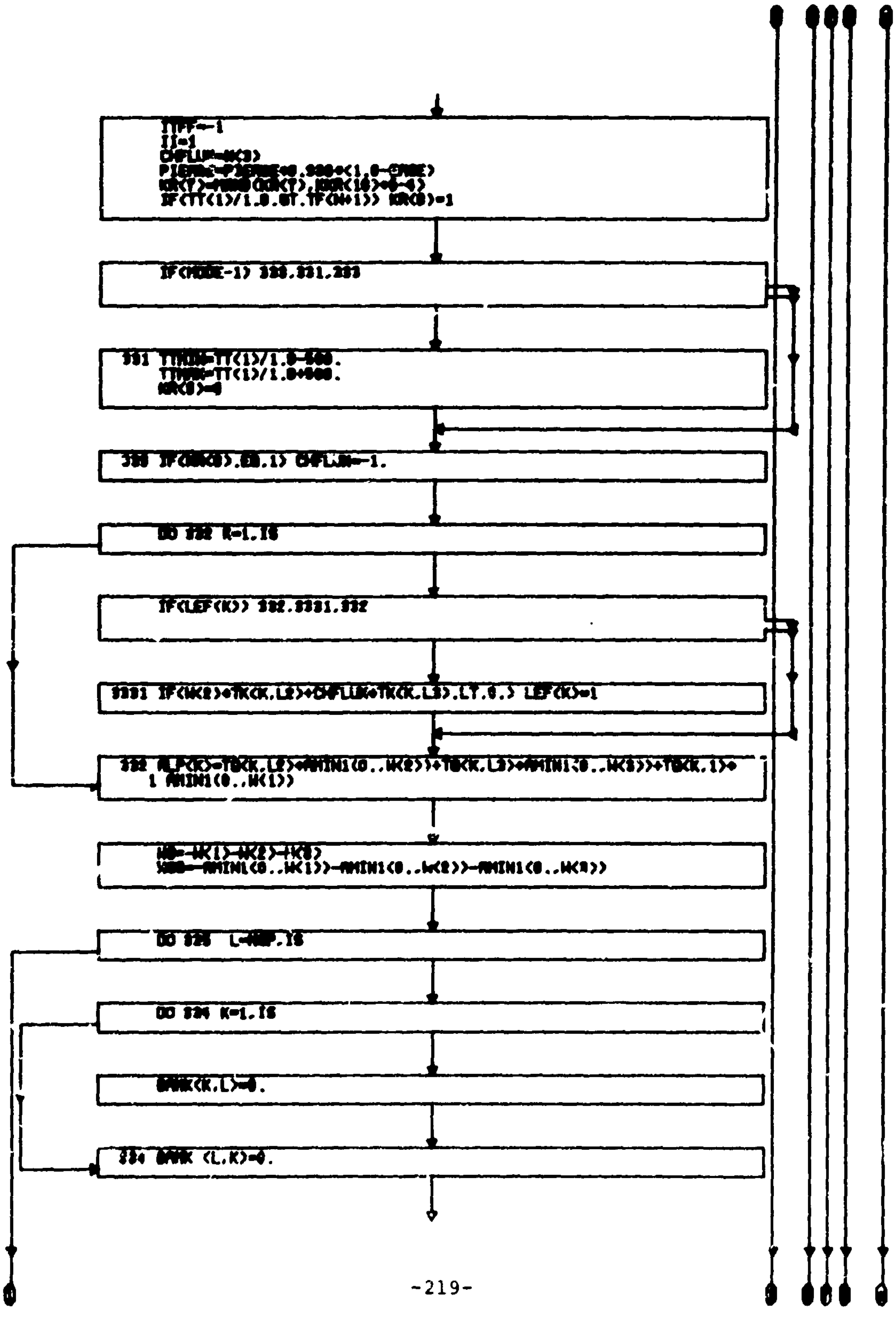
c. Flow Chart

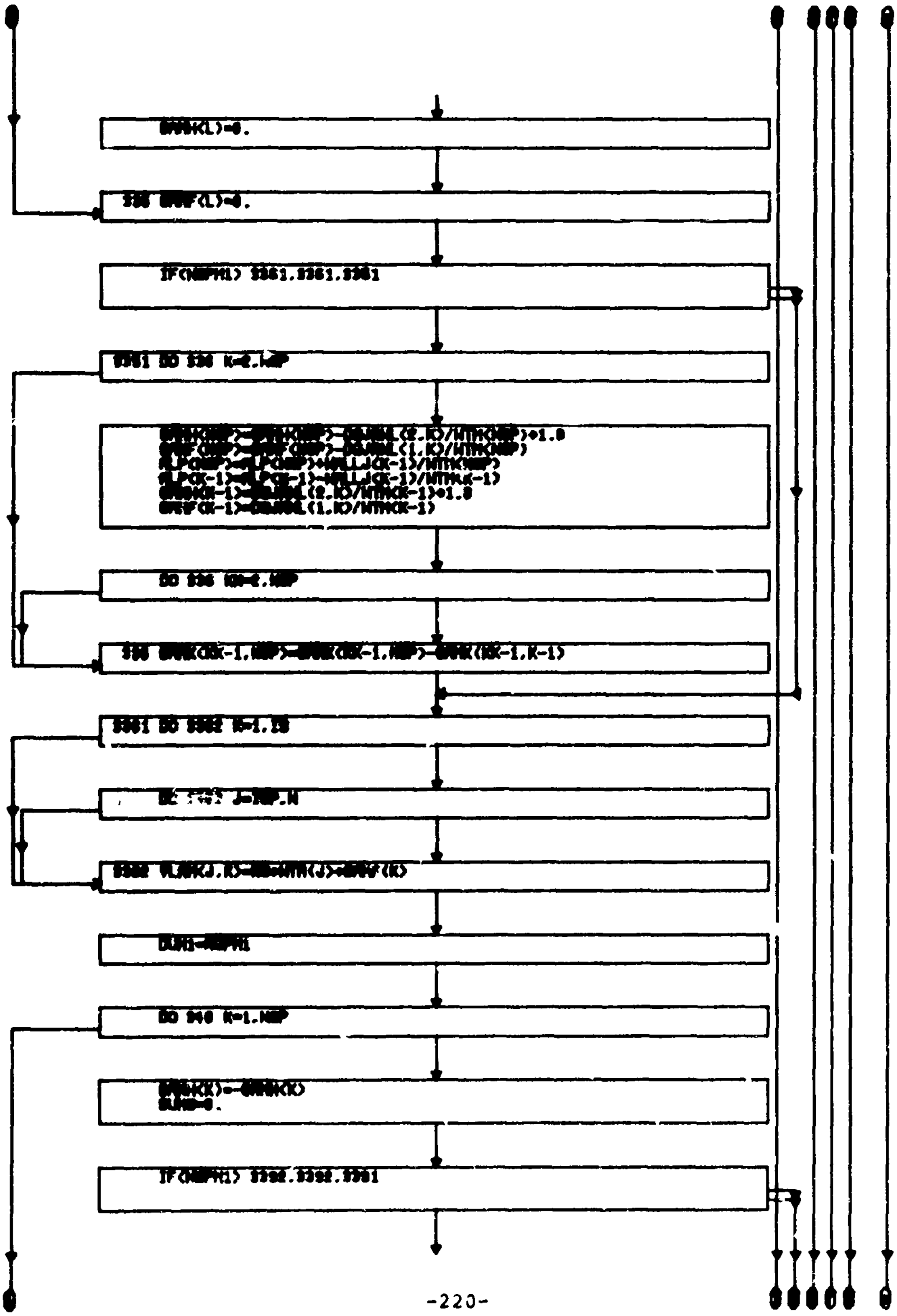


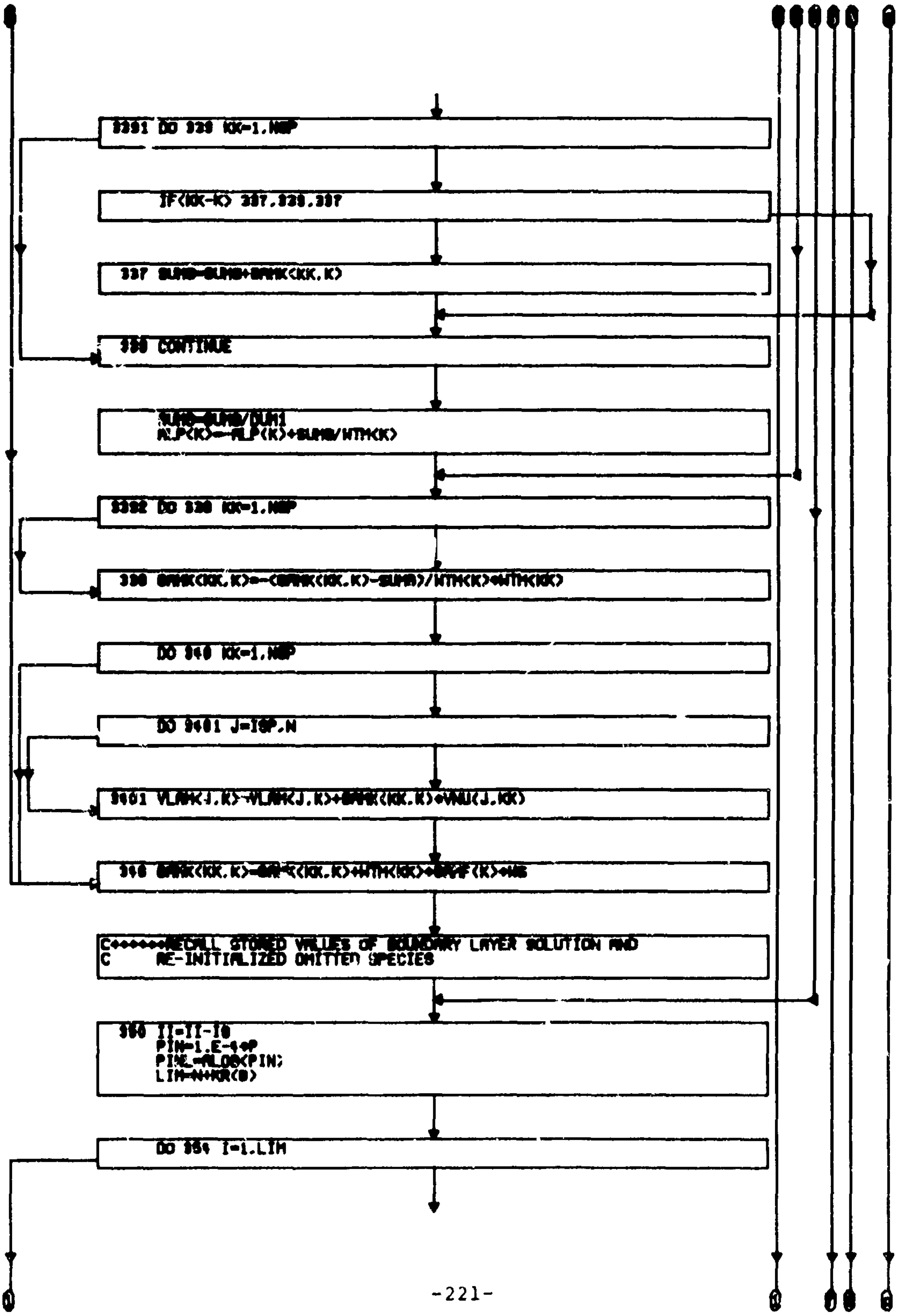

C-----BOUNDARY LAYER

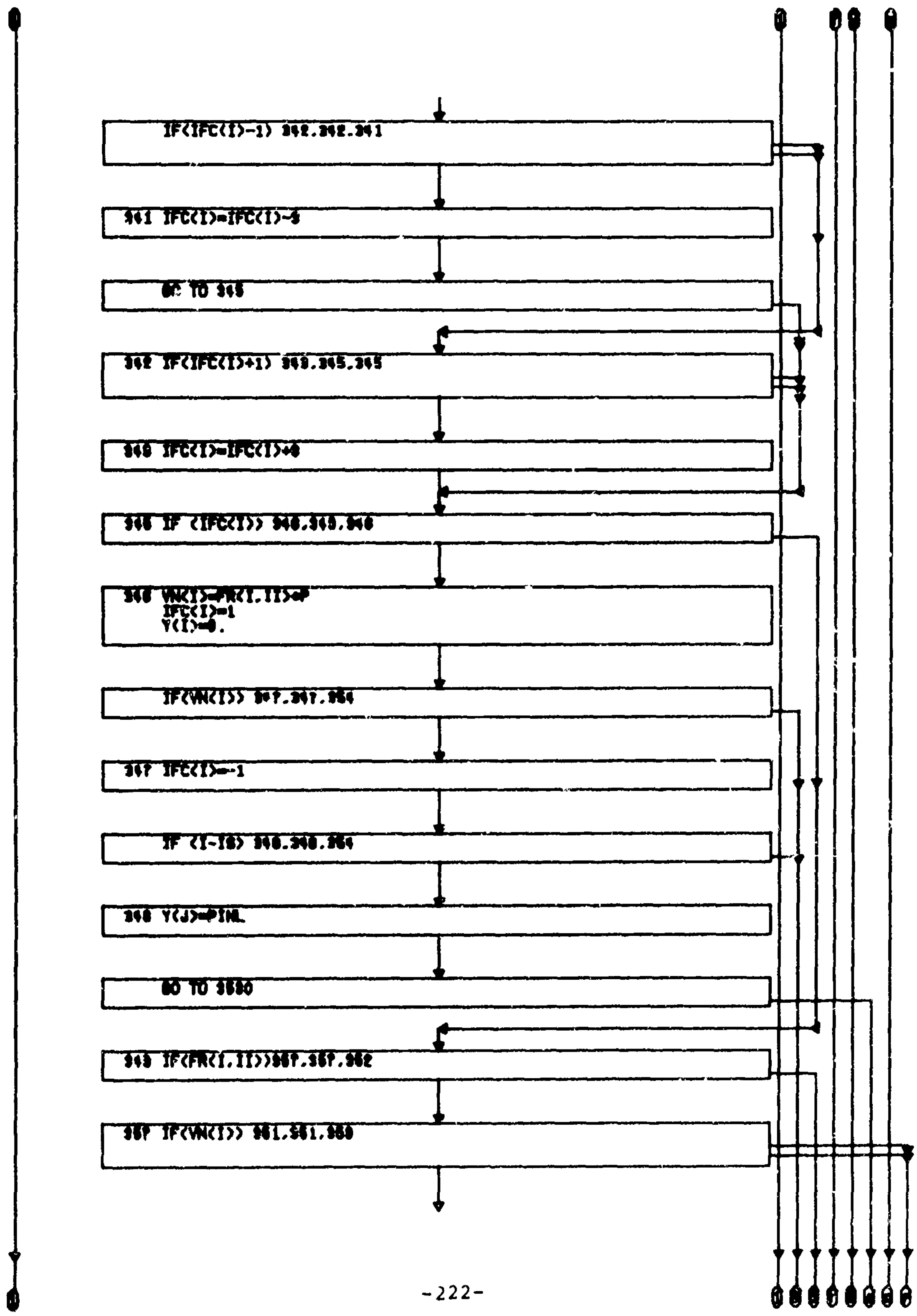

DO 313 I=1,NBP
DO 315 K=1,NBP
IF(II.EQ.1.AND.LEFW(I).EQ.1) LEF(I)=1
318 IF(II.EQ.1.AND.LEF(I).EQ.1) LEF(I)=0
LEFS(I)=-IABS(LEFS(I))
319 CONTINUE

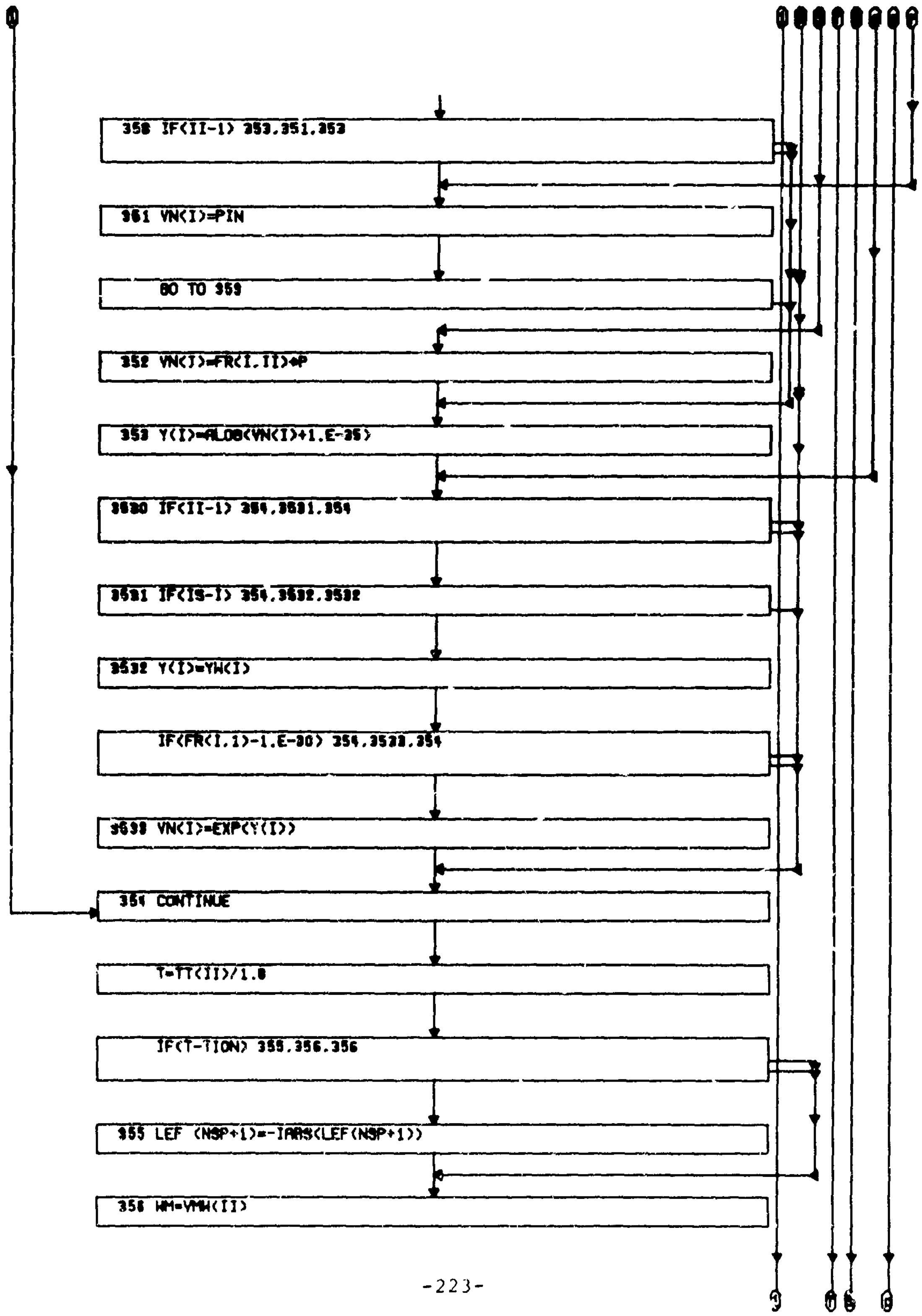

ITFF=ITFF+1
GO TO
C*****WALL SOLUTION

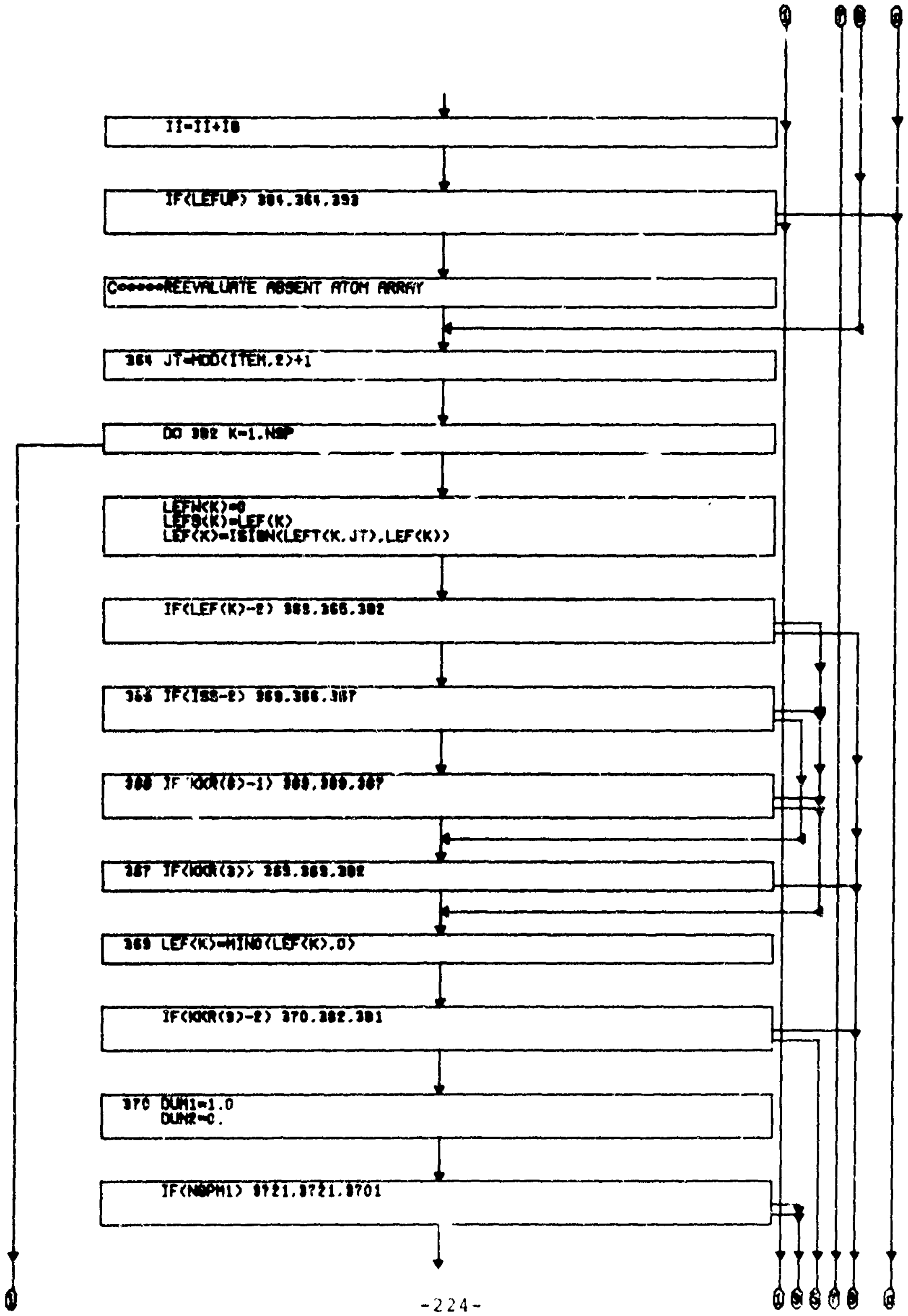

IJ=1
IF(LEF(K)) 332,3331,332
DO 334 K=1,IS
334 BARK (L,K)=0.

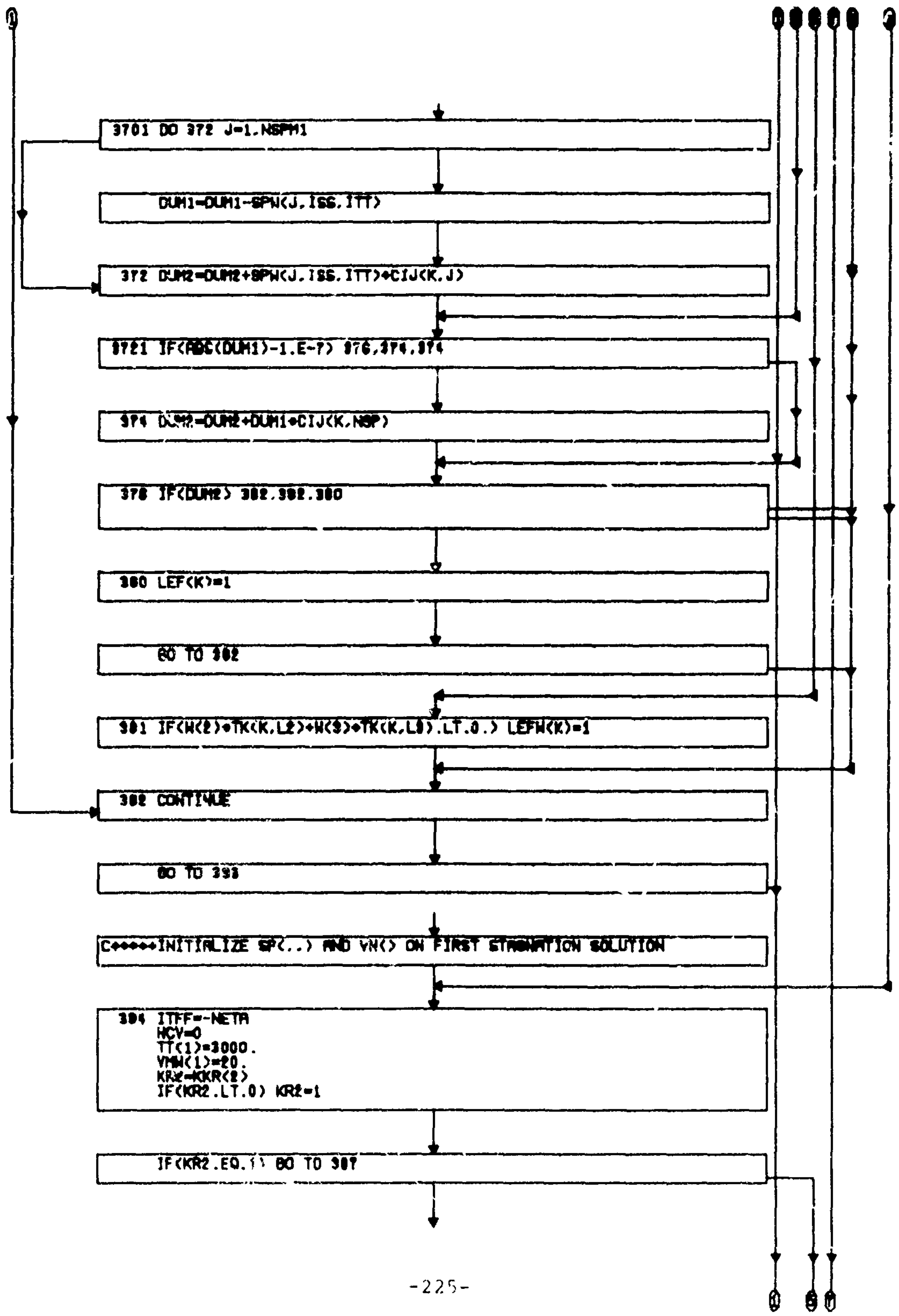


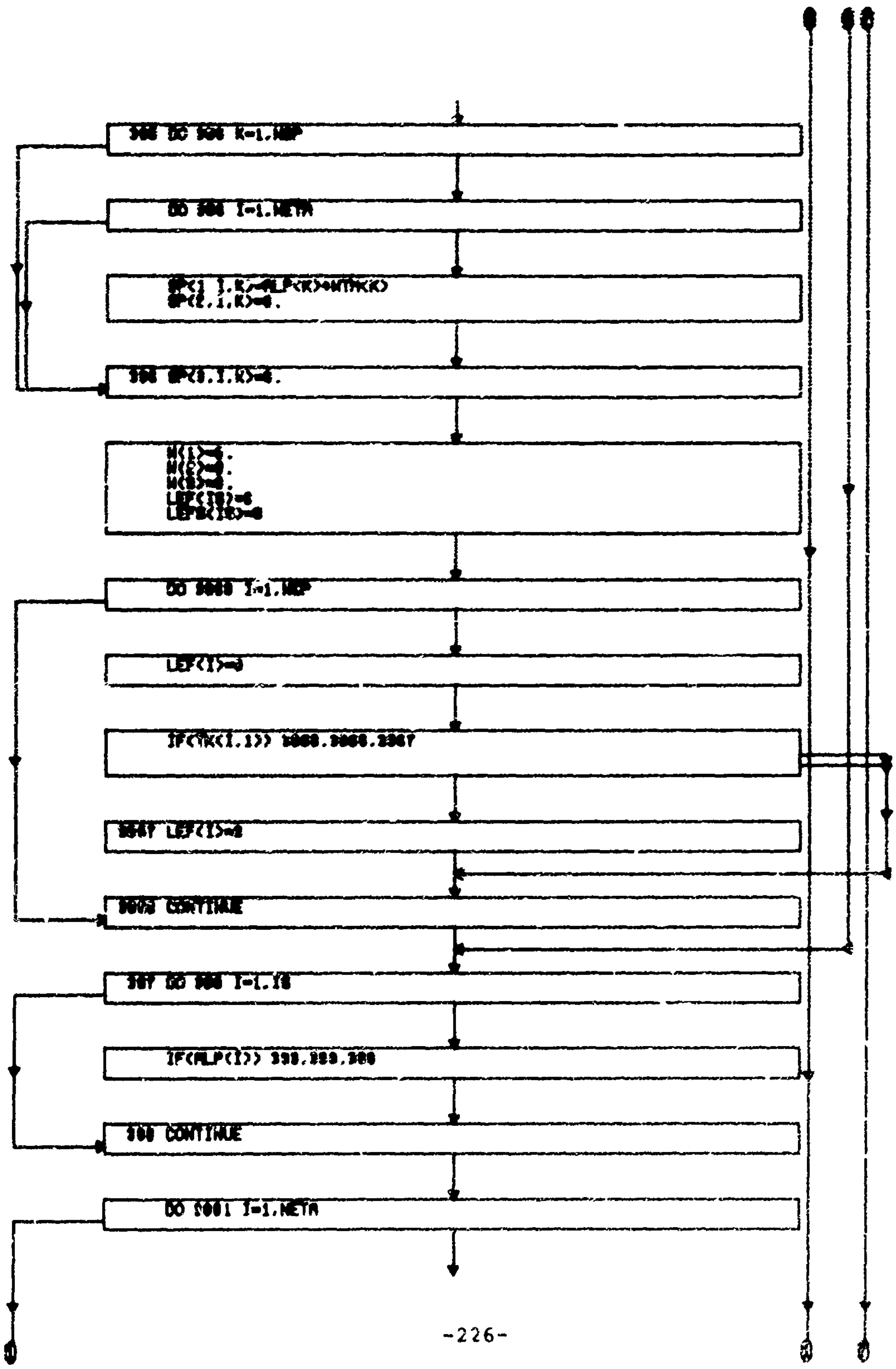

3391 DO 338 KK=1,NSP
IF(KK-K) 337,338,337
337 SUMB=SUMB+BMNK(KK,K)
338 CONTINUE
SUMB=SUMB/DUM1
ALP(K)=-ALP(K)+SUMB/WTM(K)
3392 DO 330 KK=1,NSP
330 BMNK(KK,K)=-(BMNK(KK,K)-SUMB)/WTM(K)*WTM(KK)
DO 340 KK=1,NSP
DO 3401 J=ISP,N
3401 VLAM(J,K)=VLAM(J,K)+BMNK(KK,K)*VNU(J,KK)
C*****RECALL STORED VALUES OF BOUNDARY LAYER SOLUTION AND
C RE-INITIALIZED OMITTED SPECIES
350 II=II-I0
PIN=1.E-4*P
PINL=ALOG(PIN)
DO 354 I=1,LIM

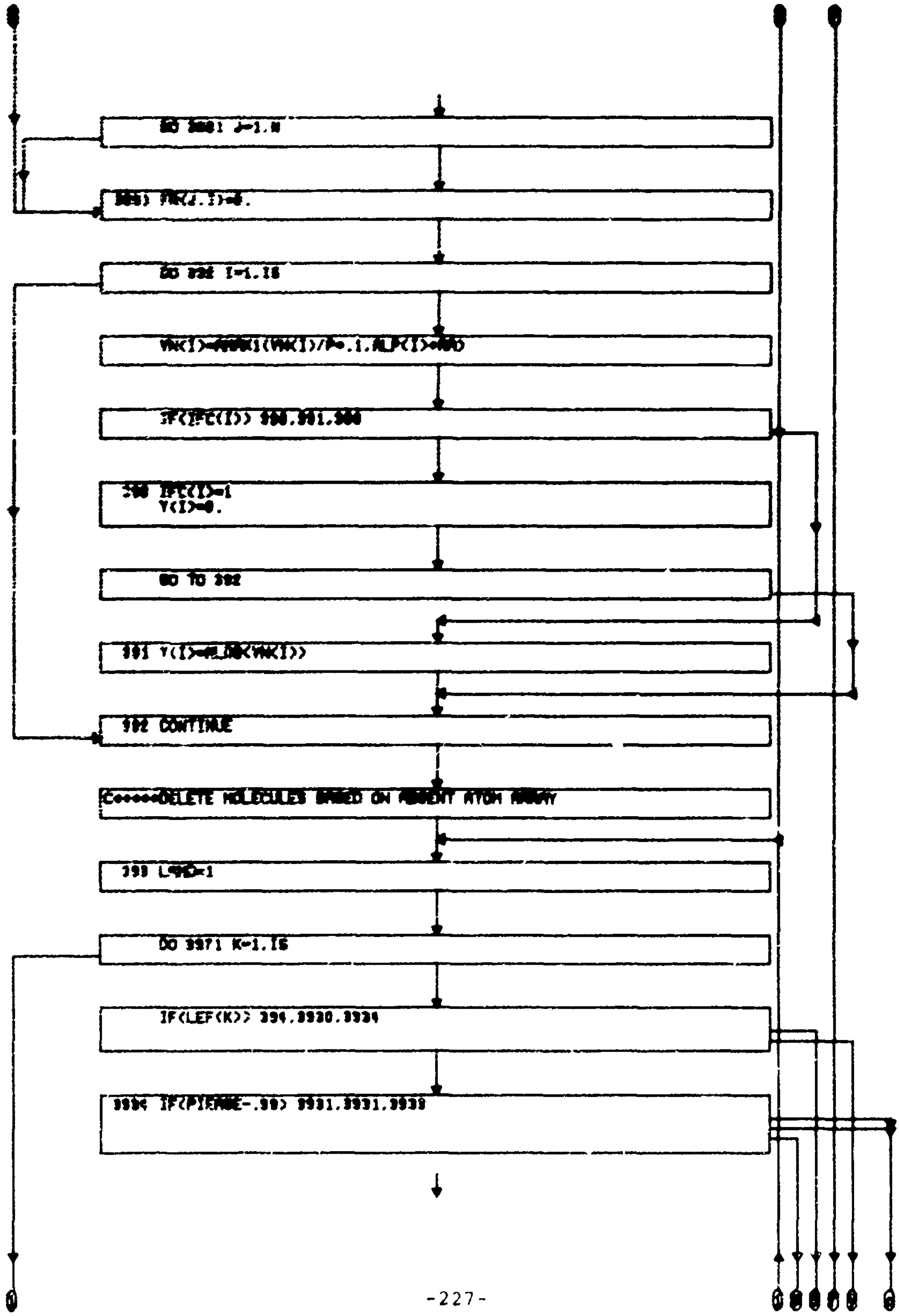

IF(IFC(I)-1) 342,342,341
341 IFC(I)=IFC(I)-3
GO TO 345
342 IF(IFC(I)+1) 343,345,345
343 IFC(I)=IFC(I)+3
345 IF (IFC(I)) 346,349,346
346 VN(I)=FR(I,II)*P
IFC(I)=1
Y(I)=0.
IF(VN(I)) 347,347,354
347 IFC(I)=-1
IF (I-IS) 348,348,354
348 Y(J)=PINL
GO TO 3580
349 IF(FR(I,II))357,357,352
357 IF(VN(I)) 351,351,350


350 IF(II-1) 353,351,353
351 VN(I)=PIN
GO TO 359
352 VN(I)=FR(I,II)*P
353 Y(I)=ALOG(VN(I)+1.E-35)
3530 IF(II-1) 354,3531,354
3531 IF(IS-1) 354,3532,3532
3532 Y(I)=YW(I)
IF(FR(I,1)-1.E-30) 354,3533,354
3533 VN(I)=EXP(Y(I))
354 CONTINUE
T=TT(II)/1.8
IF(T-TION) 355,356,356
355 LEF (NSP+1)=-IABS(LEF(NSP+1))
356 WM=VMW(II)

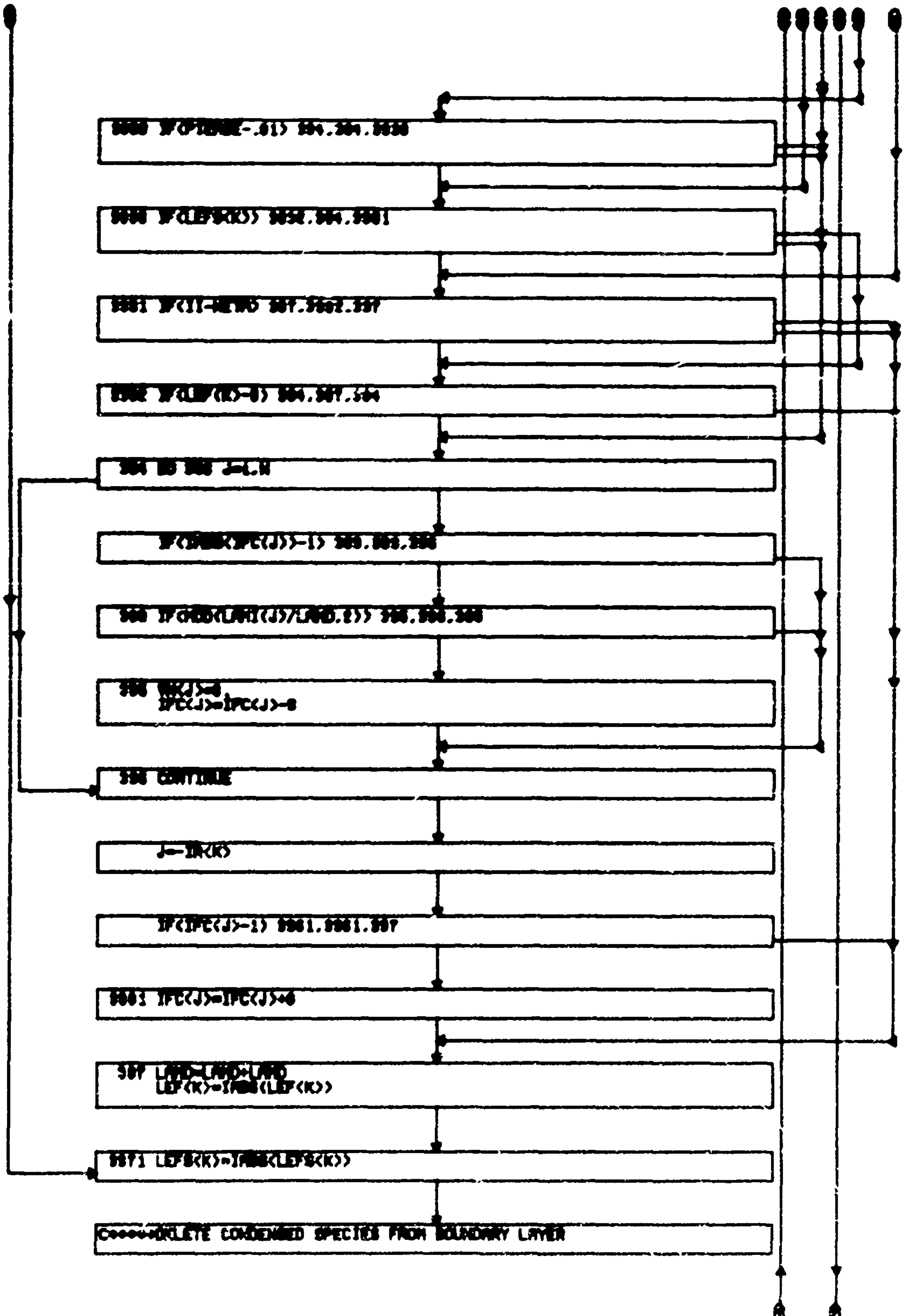

II=II+IB
IF(LEFUP) 364,364,393
C*****REEVALUATE ABSENT ATOM ARRAY
364 JT=MOD(ITEM,2)+1
DO 382 K=1,NSP
LEFN(K)=0
LEFS(K)=LEF(K)
LEF(K)=ISIGN(LEFT(K,JT),LEF(K))
IF(LEF(K)-2) 382,365,382
365 IF(ISS-2) 369,366,367
366 IF(KKR(8)-1) 369,369,367
367 IF(KKR(3)) 369,369,382
369 LEF(K)=MIN0(LEF(K),0)
IF(KKR(9)-2) 370,382,381
370 DUM1=1.0
DUM2=0.
IF(NSPM1) 3721,3721,3701

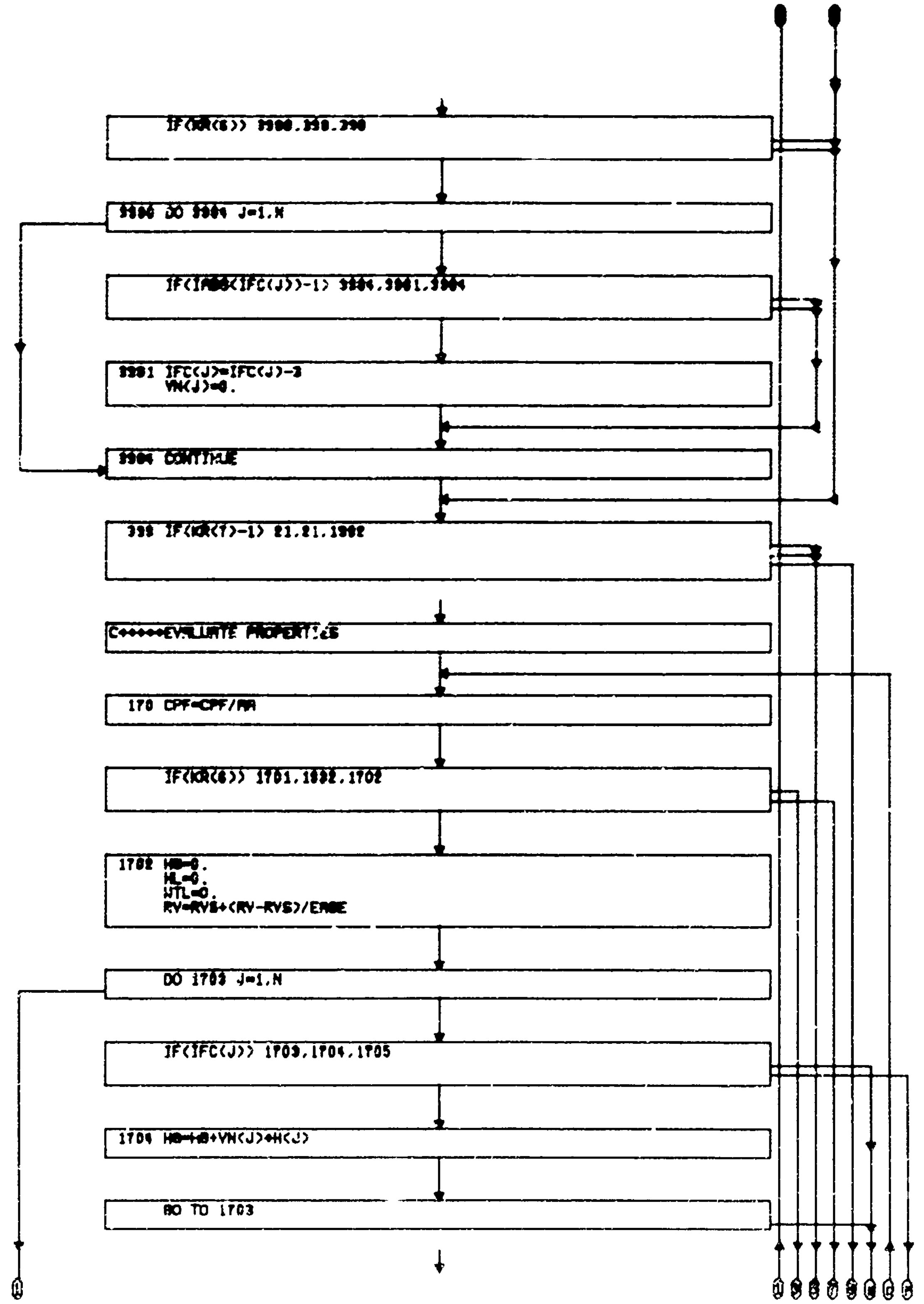

3701 DO 372 J=1,NSPM1
DUM1=DUM1-SPW(J,ISS,ITT)
372 DUM2=DUM2+SPW(J,ISS,ITT)*CIJ(K,J)
3721 IF(ABS(DUM1)-1.E-7) 376,374,374
374 DUM2=DUM2+DUM1*CIJ(K,NSP)
376 IF(DUM2) 382,382,380
380 LEF(K)=1
GO TO 382
381 IF(W(2)*TK(K,L2)+W(3)*TK(K,L3).LT.0.) LEFW(K)=1
382 CONTINUE
GO TO 393
C*****INITIALIZE SP(..) AND VN() ON FIRST STAGNATION SOLUTION
394 ITFF=-NETA
HCV=0
TT(1)=3000.
VMW(1)=20.
KR2=KKR(2)
IF(KR2.LT.0) KR2=1
IF(KR2.EQ.1) GO TO 397

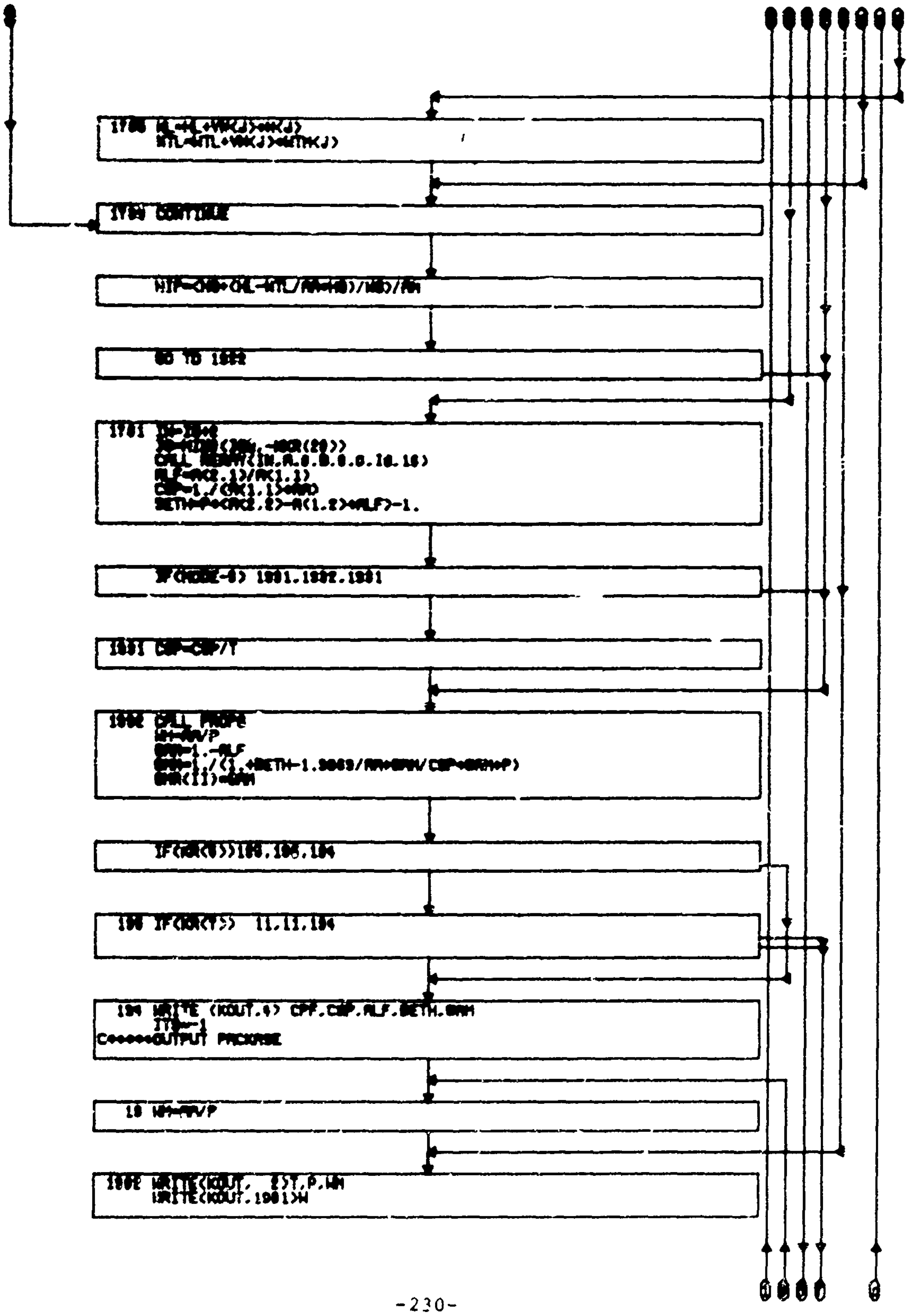

DO 5001 I=1,NETA

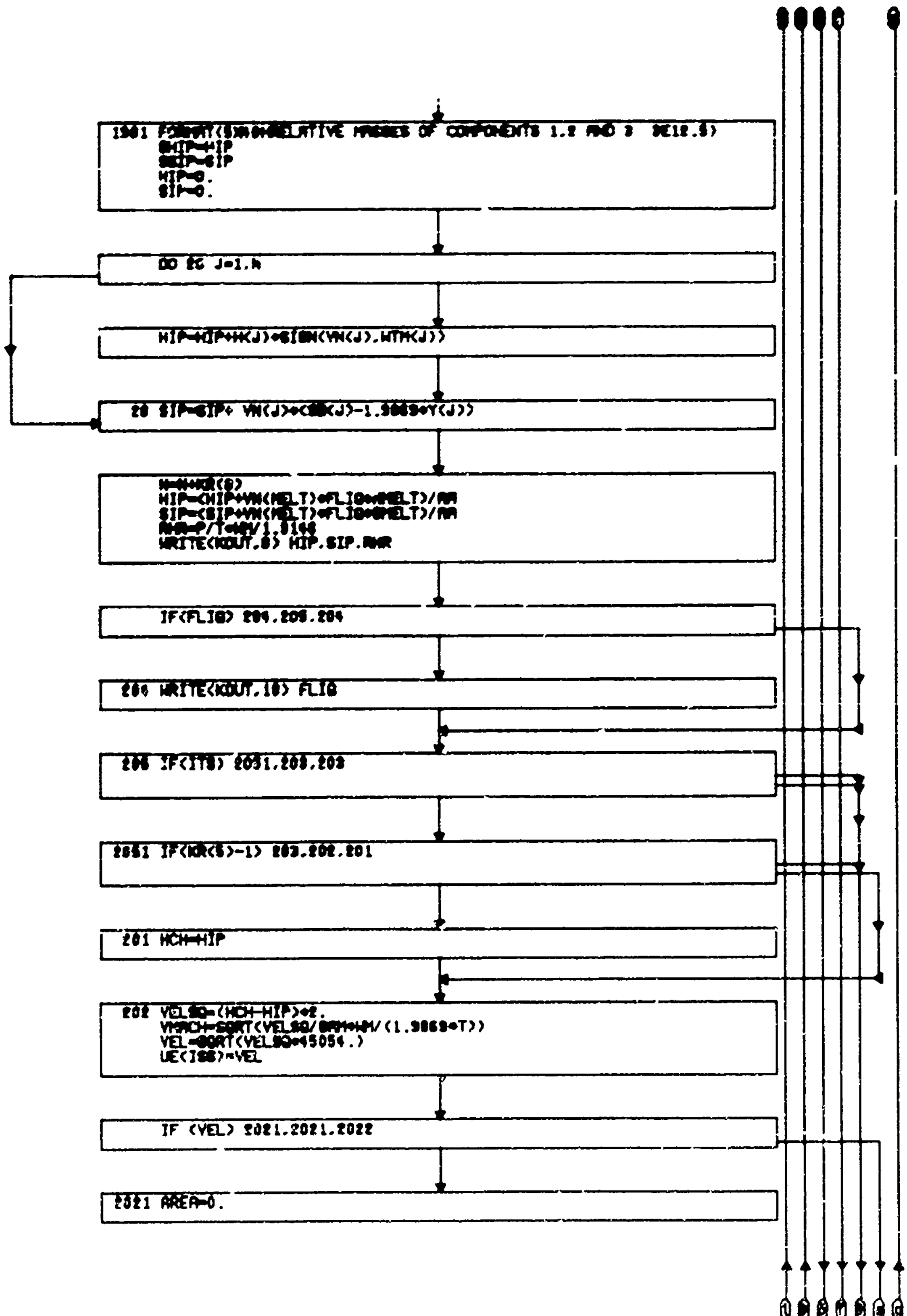


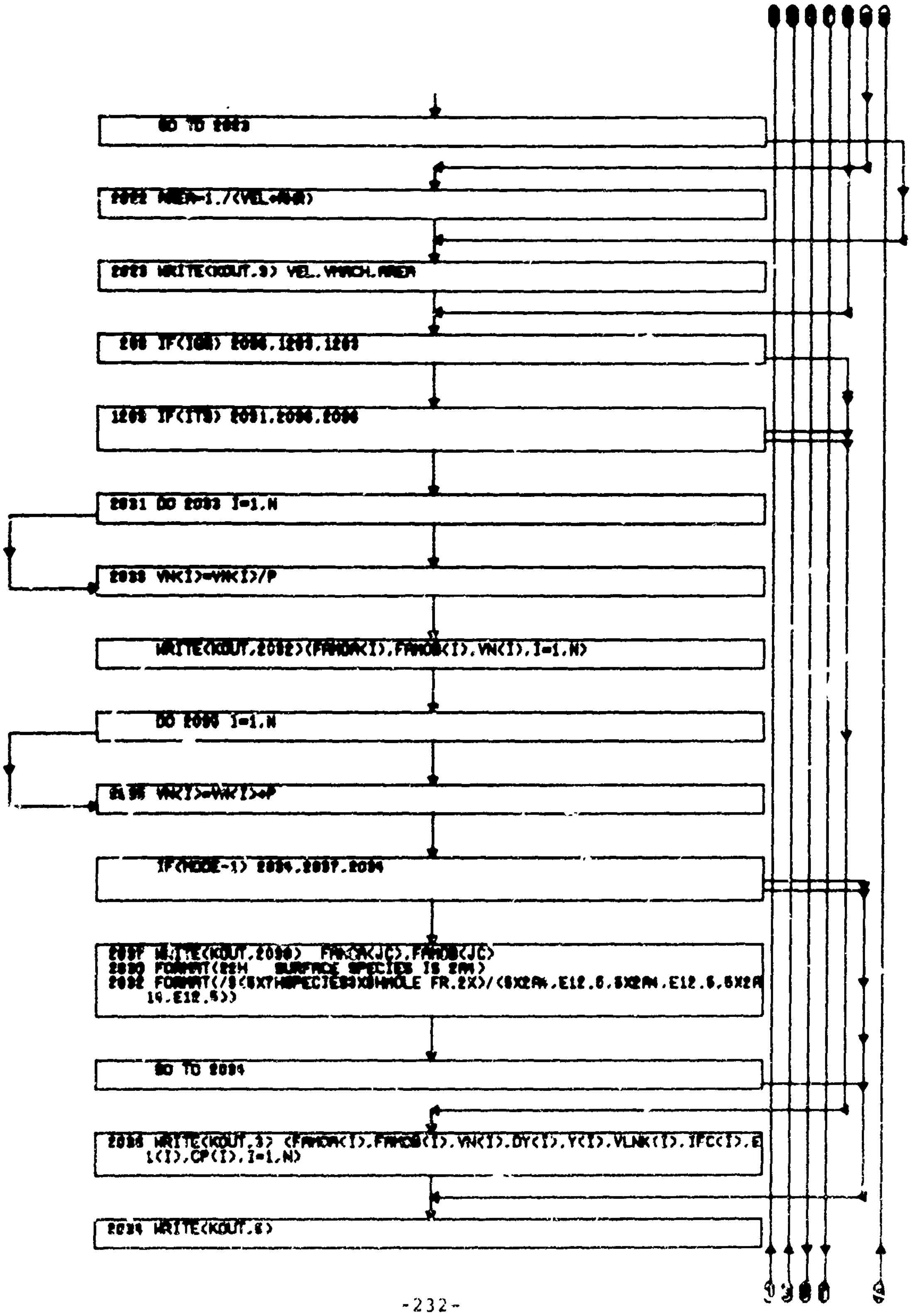
DO 3881 J=1.N
C+++++DELETE MOLECULES BASED ON ABSENT ATOM ARRAY
DO 3971 K=1.IS
IF(LEF(K)) 394.3930.3934

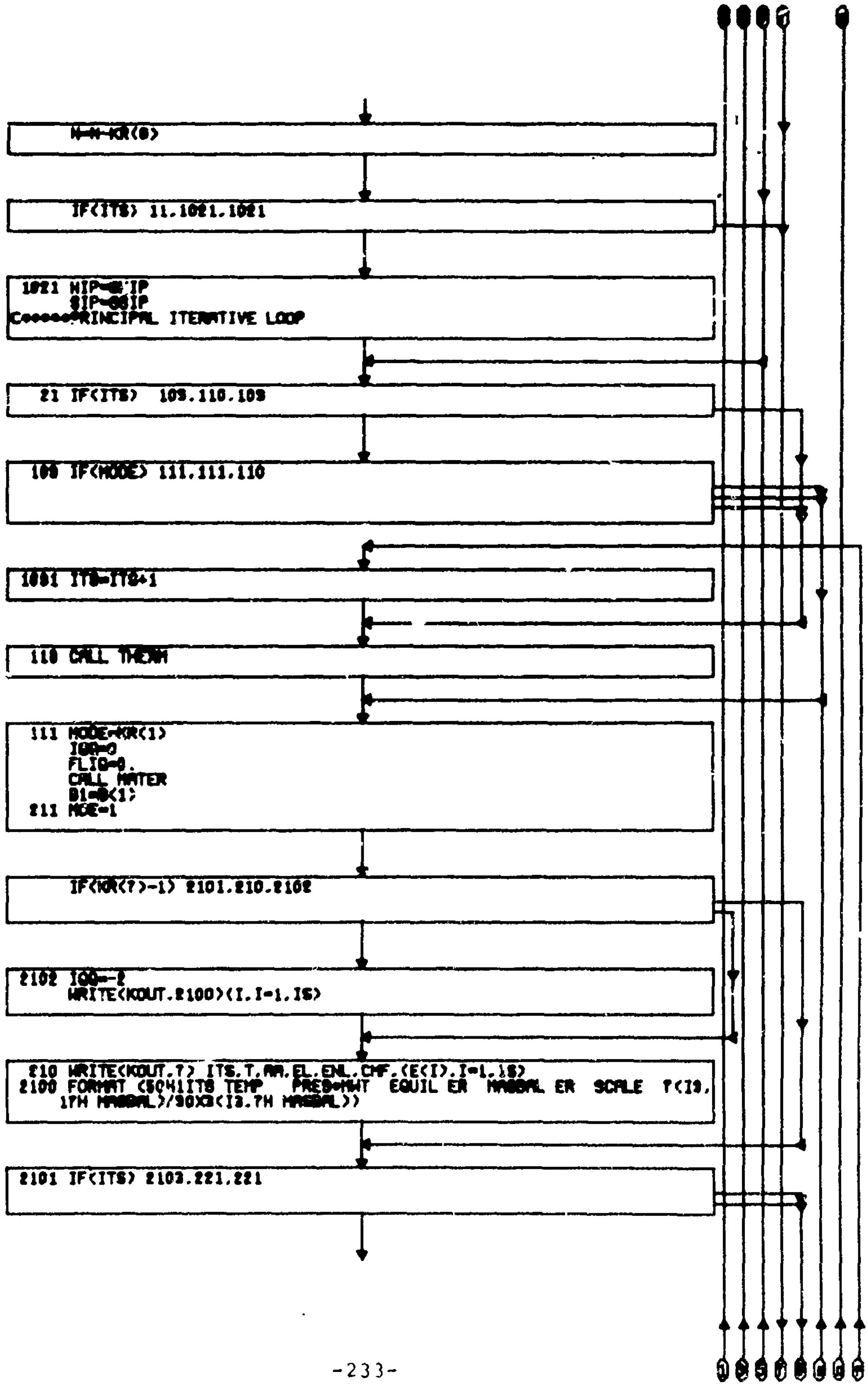

CONTINUE
LEFS(K)=IABS(LEFS(K))
C*****DELETE CONDENSED SPECIES FROM BOUNDARY LAYER

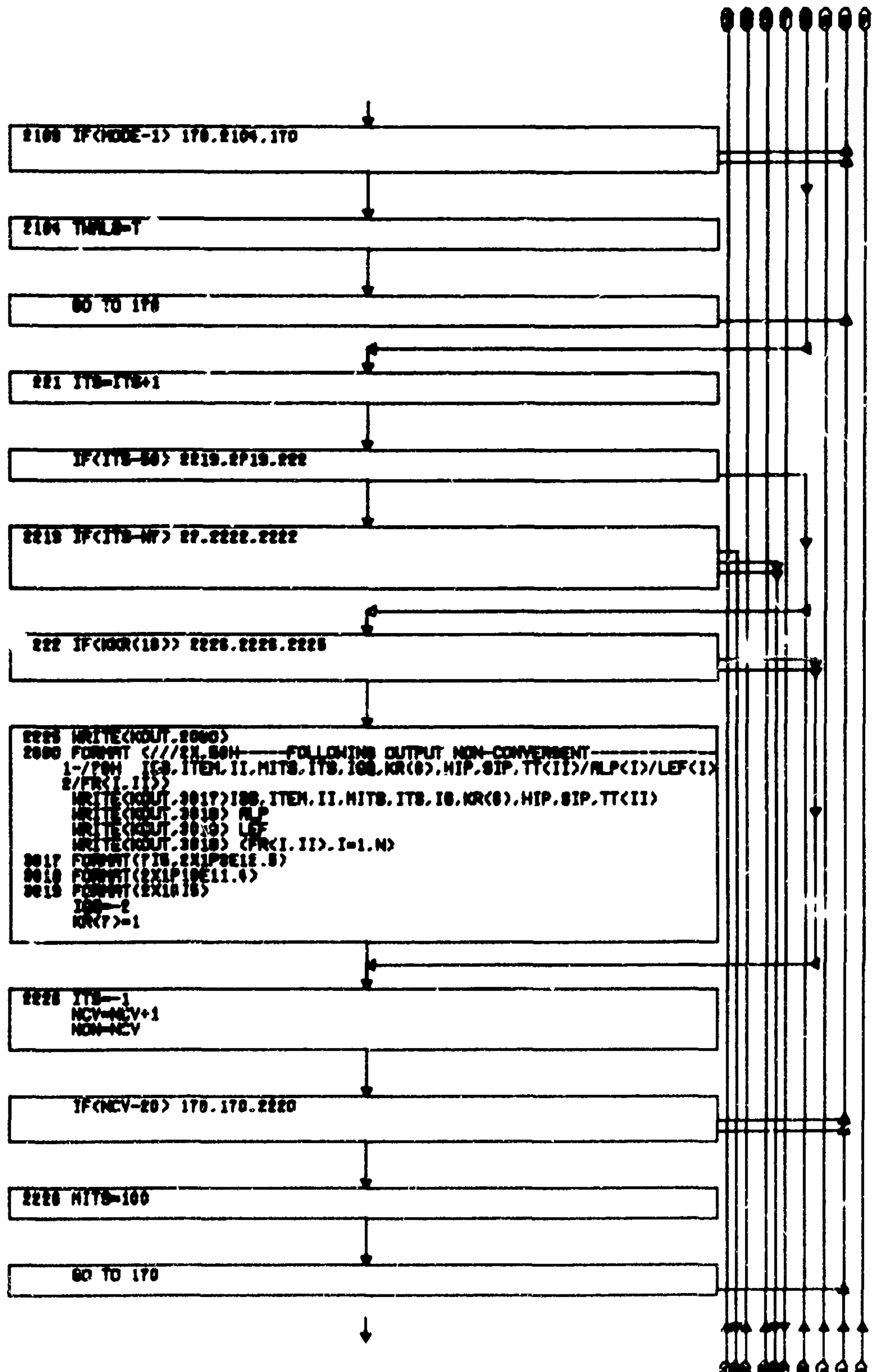

IF(KR(6)) 3900,398,398
3900 DO 3904 J=1,N
IF(IABS(IFC(J))-1) 3904,3901,3904
3901 IFC(J)=IFC(J)-3
VN(J)=0.
3904 CONTINUE
398 IF(KR(7)-1) 21,21,1902
C+++++EVALUATE PROPERTIES
170 CPF=CPF/RR
IF(KR(6)) 1701,1902,1702
1702 HB=0.
HL=0.
WTL=0.
RV=RVS+(RV-RVS)/ERGE
DO 1703 J=1,N
IF(IFC(J)) 1703,1704,1705
1704 HB=HB+VN(J)*H(J)
GO TO 1703

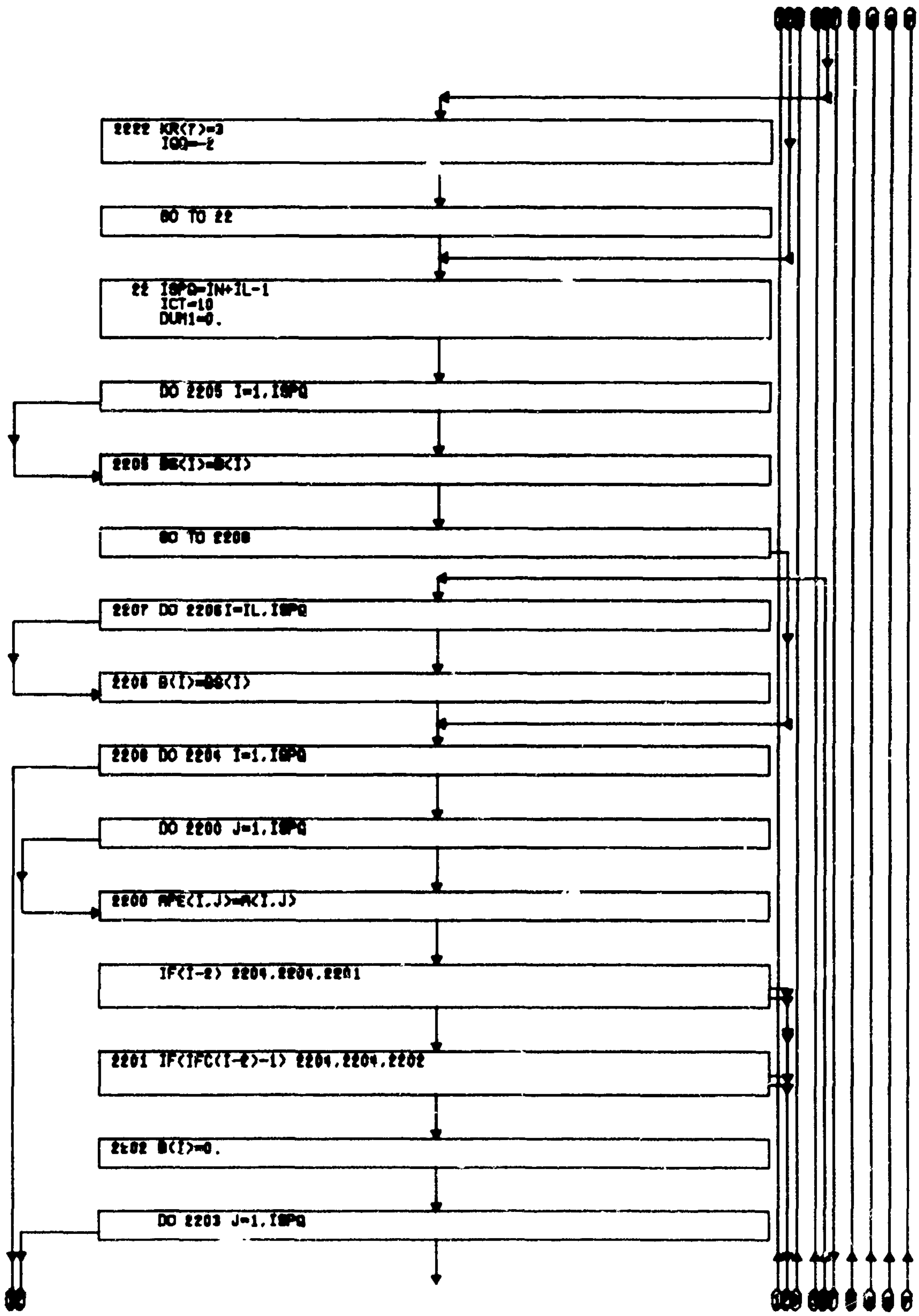

CONTINUE
GO TO 1902
1901 CSP=CSP/T
C*****OUTPUT PACKAGE

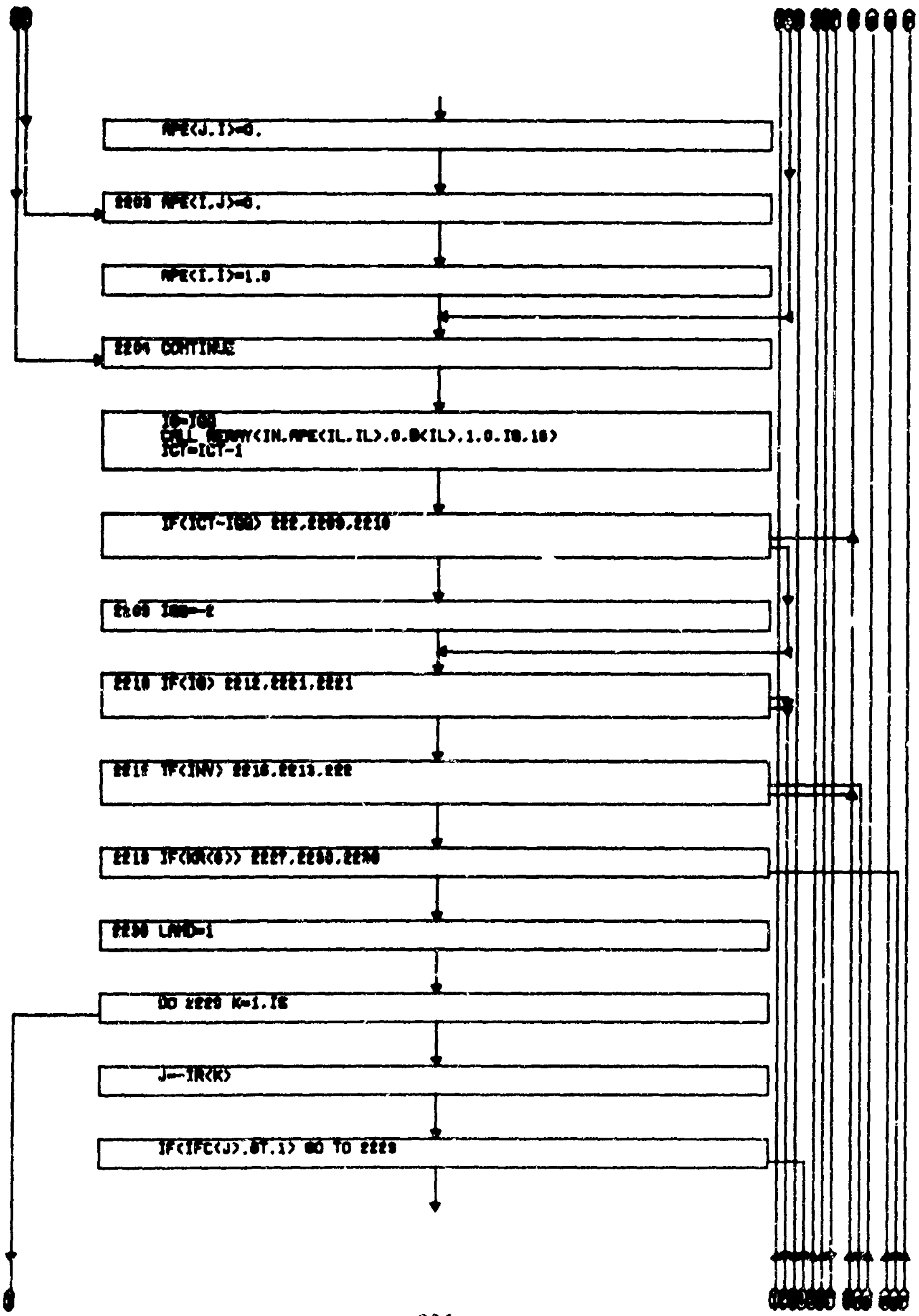

1501 FORMAT(5X,ELATIVE MASSES OF COMPONENTS 1,2 AND 3 3E12.5)
HIP=HIP
SIP=SIP
HIP=0.
SIP=0.
DO 20 J=1,N
HIP=HIP+H(J)*SIGN(VN(J),WTM(J))
20 SIP=SIP+ VN(J)*(S(J)-1.9869*Y(J))
HIP=(HIP+VN(MELT)*FLIQ*HMELT)/AA
SIP=(SIP+VN(MELT)*FLIQ*SMELT)/AA
WRITE(KOUT,8) HIP,SIP,RHR
IF(FLIQ) 204,205,204
204 WRITE(KOUT,10) FLIQ
205 IF(ITS) 2051,203,203
2051 IF(KR(5)-1) 203,202,201
201 HCH=HIP
202 VELSQ=(HCH-HIP)*2.
VEL=SQRT(VELSQ*45054.)
UE(ISS)=VEL
IF (VEL) 2021,2021,2022
2021 AREA=0.

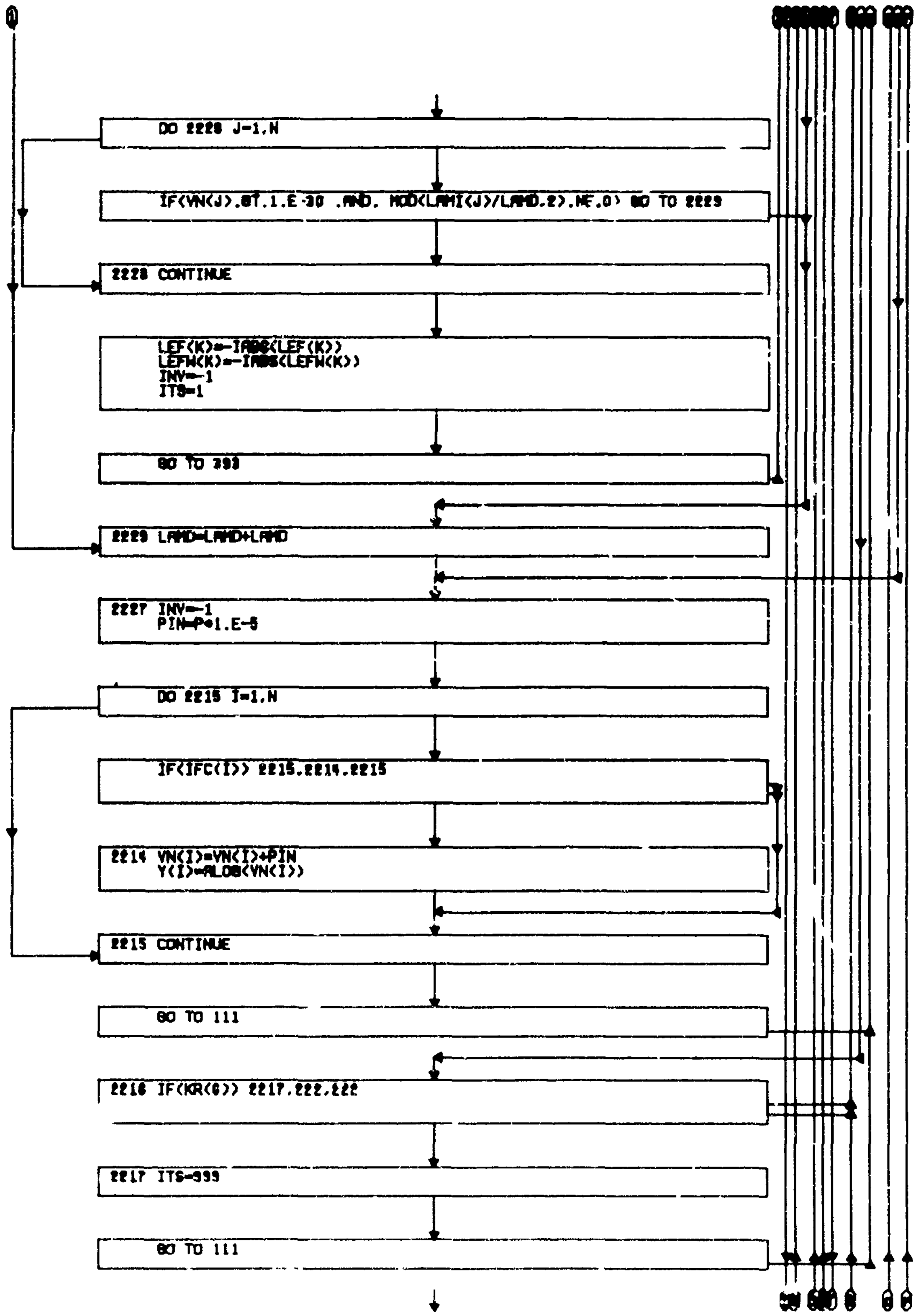

2083 WRITE(KOUT,9) VEL,VMACH,AREA
2031 DO 2033 I=1,N
2033 VN(I)=VN(I)/P
WRITE(KOUT,2032)(FAMOA(I),FAMOB(I),VN(I),I=1,N)
IF(MODE-1) 2034,2037,2034
2030 FORMAT(22H SURFACE SPECIES IS 2A4)
2034 WRITE(KOUT,6)

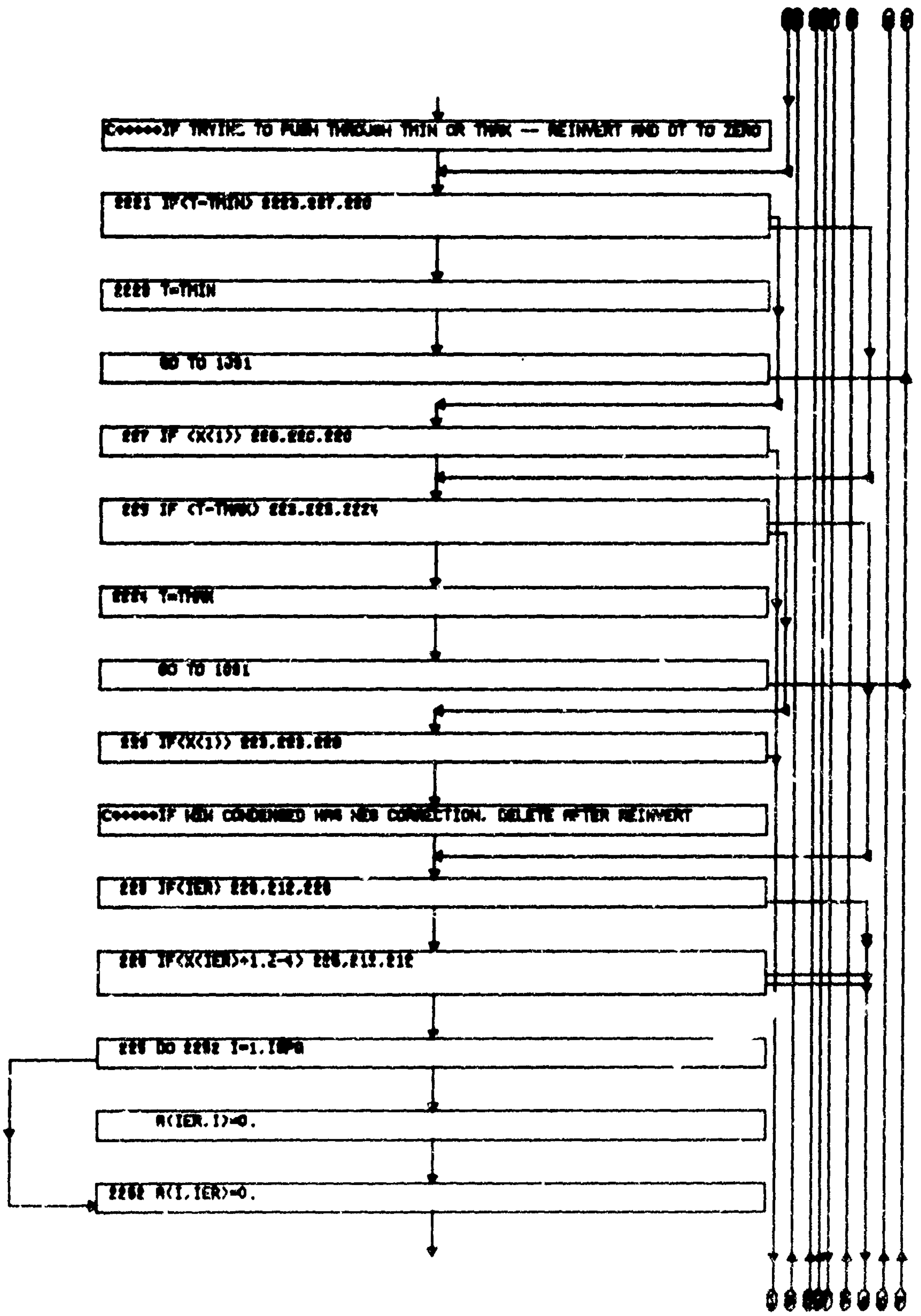

N=N-KR(8)
IF(ITS) 11.1021.1021
1021 HIP=GHIP
SIP=GSIP
C.....PRINCIPAL ITERATIVE LOOP
21 IF(ITS) 109.110.109
109 IF(MODE) 111.111.110
1001 ITS=ITS+1
110 CALL THERM
111 MODE=KR(1)
IGG=0
FLIG=0.
CALL MATER
B1=B(1)
211 MOE=1
IF(KR(7)-1) 2101.210.2102
2102 IGG=-2
WRITE(KOUT.2100)(I.I=1.IS)
210 WRITE(KOUT.7) ITS.T.AA.EL.ENL.CMF.(E(I).I=1.IS)
2100 FORMAT (50H1ITS TEMP PRES=MWT EQUIL ER MASBAL ER SCALE T(I3,
1TH MASBAL)/30X3(I3.7H MASBAL))
2101 IF(ITS) 2103.221.221

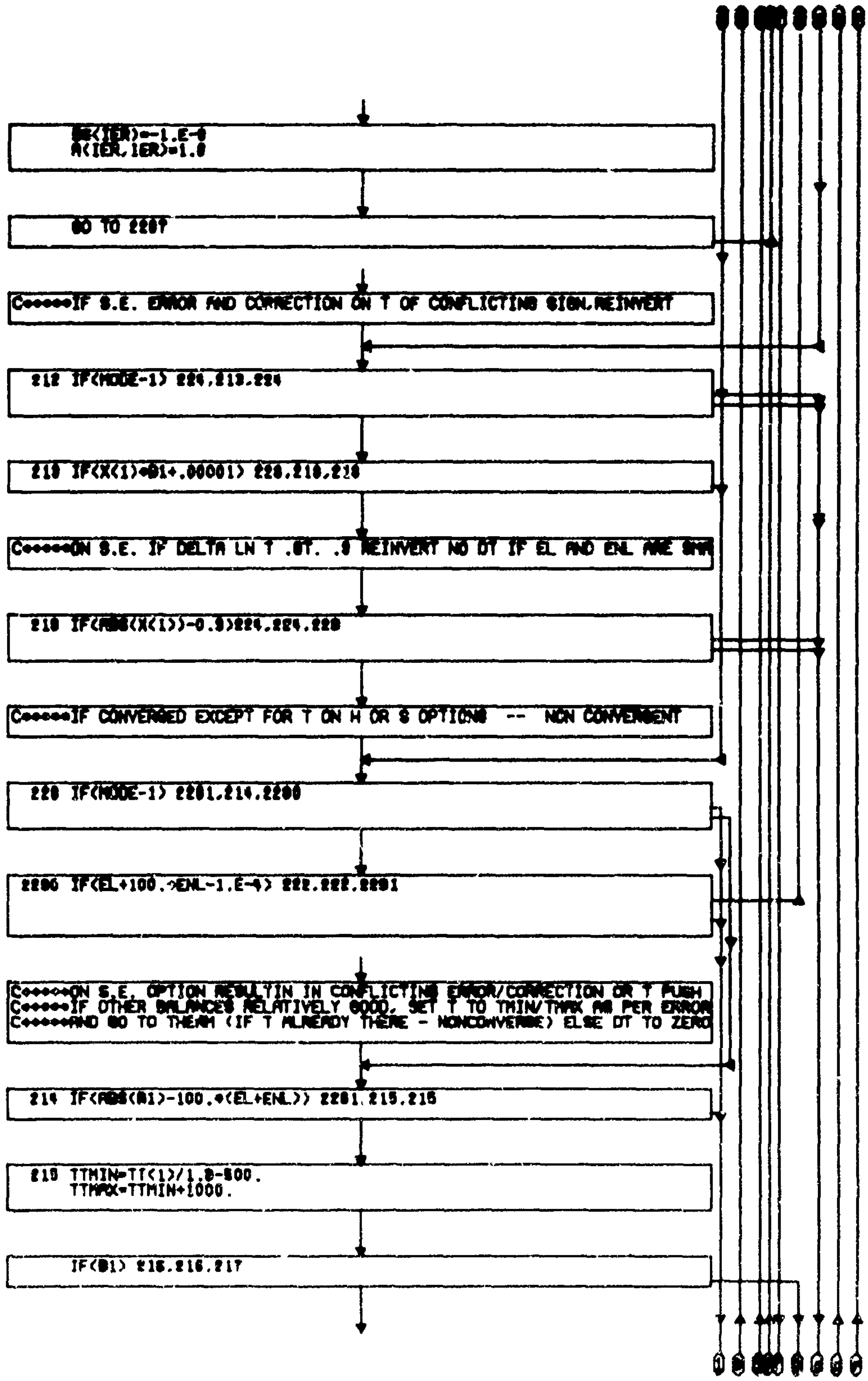

2100 IF(MODE-1) 170.2104.170
2104 TWALB=T
GO TO 170
221 ITS=ITS+1
IF(ITS-50) 2219.2219.222
2219 IF(ITS-NF) 27.2222.2222
222 IF(KKR(18)) 2226.2226.2225
2225 WRITE(KOUT.2000)
2000 FORMAT (///2X.50H-----FOLLOWING OUTPUT NON-CONVERGENT-----
1-/70H ISS.ITEM.II.MITS.ITS.ISS.KR(8).HIP.SIP.TT(II)/ALP(I)/LEF(I)
2/FR(I.II))
WRITE(KOUT.3017)ISS.ITEM.II.MITS.ITS.IS.KR(8).HIP.SIP.TT(II)
WRITE(KOUT.3018) ALP
WRITE(KOUT.3018) LEF
WRITE(KOUT.3019) (FR(I.II).I=1.N)
3017 FORMAT(7I5.2X1P3E12.5)
3018 FORMAT(2X1P10E11.4)
3019 FORMAT(2X10I5)
ISS=-2
KR(7)=1
2226 ITS=-1
NCV=NCV+1
NON=NCV
IF(NCV-20) 170.170.2220
2220 MITS=100
GO TO 170

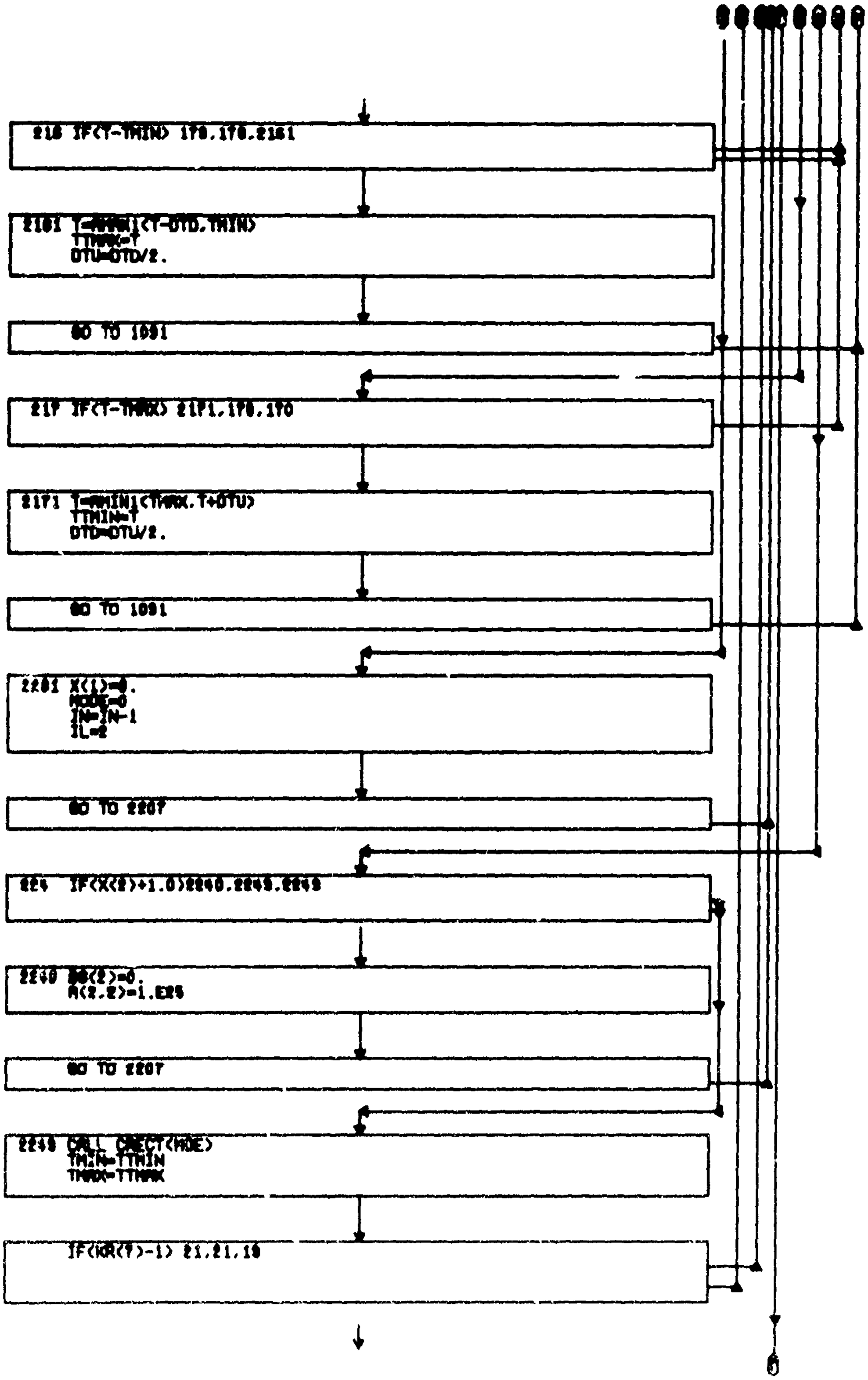

2222 KR(7)=3
IQQ=-2
GO TO 22
22 ISPQ=IN+IL-1
ICT=10
DUM1=0.
DO 2205 I=1,ISPQ
2205 BS(I)=B(I)
GO TO 2208
2207 DO 2206 I=IL,ISPQ
2206 B(I)=BS(I)
2208 DO 2204 I=1,ISPQ
DO 2200 J=1,ISPQ
2200 APE(I,J)=A(I,J)
IF(I-2) 2204,2204,2201
2201 IF(IFC(I-2)-1) 2204,2204,2202
2t02 B(I)=0.
DO 2203 J=1,ISPQ

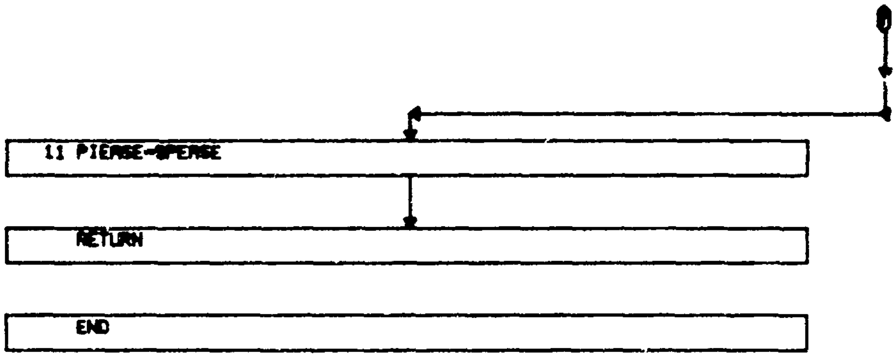

APE(J.I)=0.
APE(I.I)=1.0
CONTINUE
ICT=ICT-1
J=-IR(K)


DO 2228 J=1,N
IF(VN(J).GT.1.E-30 .AND. MOD(LAMI(J)/LAMD,2).NE.0) GO TO 2229
2228 CONTINUE
LEF(K)=-IABS(LEF(K))
LEFW(K)=-IABS(LEFW(K))
INV=-1
ITS=1
GO TO 393
2229 LAMD=LAMD+LAMD
2227 INV=-1
PIN=P*1.E-5
DO 2215 I=1,N
IF(IFC(I)) 2215,2214,2215
2214 VN(I)=VN(I)+PIN
Y(I)=ALOG(VN(I))
2215 CONTINUE
GO TO 111
2216 IF(KR(6)) 2217,222,222
2217 ITS=999
GO TO 111


C*****IF TRYING TO PUSH THROUGH THIN OR THAK -- REINVERT AND DT TO ZERO
2221 IF(T-THIN) 2223,227,228
2223 T=THIN
GO TO 1301
227 IF (X(1)) 226,22C,228
229 IF (T-THAK) 223,223,2224
2224 T=THAK
GO TO 1001
228 IF(X(1)) 223,223,228
C*****IF NEW CONDENSED HAS NEG CONNECTION. DELETE AFTER REINVERT
223 IF(IER) 226,212,226
226 IF(X(IER)+1.2-4) 226,212,212
226 DO 2202 I=1,IEPA
A(IER,I)=0.
2202 A(I,IER)=0.


BE(IER)=-1.E-8
A(IER,IER)=1.8
GO TO 2207
C•••••IF S.E. ERROR AND CORRECTION ON T OF CONFLICTING SIGN,REINVERT
212 IF(MODE-1) 224,213,224
213 IF(X(1)-B1+.00001) 228,218,218
C•••••ON S.E. IF DELTA LN T .GT. .5 REINVERT NO DT IF EL AND ENL ARE SMA
218 IF(ABS(X(1))-0.5)224,224,228
C•••••IF CONVERGED EXCEPT FOR T ON H OR S OPTIONS -- NON CONVERGENT
228 IF(MODE-1) 2281,214,2280
2280 IF(EL+100.*ENL-1.E-4) 222,222,2281
C•••••ON S.E. OPTION RESULTIN IN CONFLICTING ERROR/CORRECTION OR T PUSH
C•••••IF OTHER BALANCES RELATIVELY GOOD, SET T TO TMIN/TMAX AS PER ERROR
C•••••AND GO TO THERM (IF T ALREADY THERE - NONCONVERGE) ELSE DT TO ZERO
214 IF(ABS(A1)-100.*(EL+ENL)) 2281,215,215
215 TTMIN=TT(1)/1.8-500.
TTMAX=TTMIN+1000.
IF(B1) 216,216,217


216 IF(T-TMIN) 170,170,2161
2161 T=AMAX1(T-DTD,TMIN)
TTMAX=T
DTU=DTD/2.
GO TO 1091
217 IF(T-TMAX) 2171,170,170
2171 T=AMIN1(TMAX,T+DTU)
TTMIN=T
DTD=DTU/2.
GO TO 1091
2201 X(1)=0.
MODE=0
IN=IN-1
IL=2
GO TO 2207
224 IF(X(2)+1.0)2240,2245,2245
2240 B(2)=0.
A(2,2)=1.E25
GO TO 2207
2245 CALL CRECT(MOE)
TMIN=TTMIN
TMAX=TTMAX
IF(KR(7)-1) 21,21,19


11 PIERSE=SPERSE
RETURN
END

22. SUBROUTINE THERM - B21A

a. Function

Evaluates current thermodynamic properties for each species, which data are required for evaluation of errors and correction coefficients in chemistry solution. Called by EQUIL.

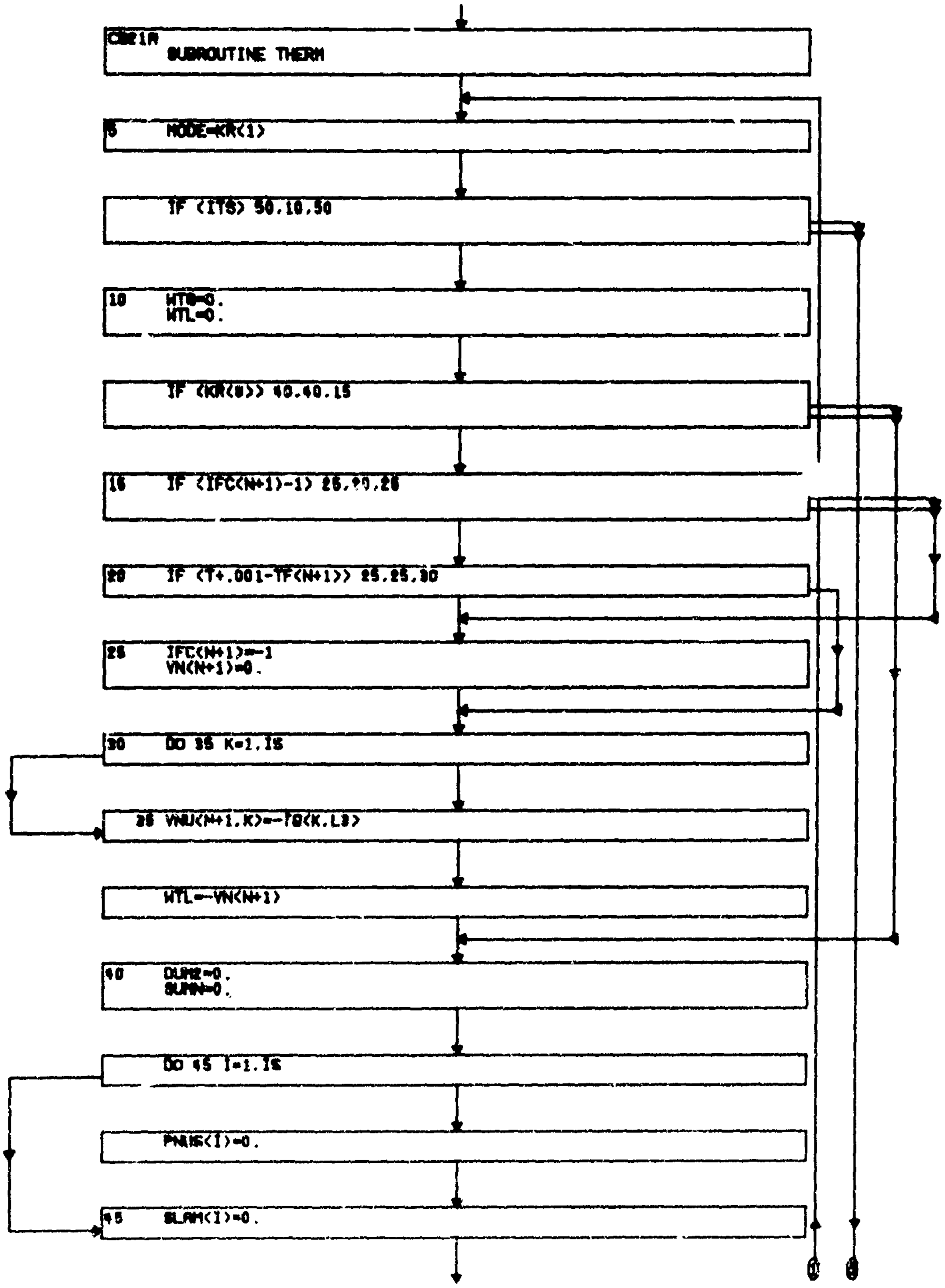
b. Listing

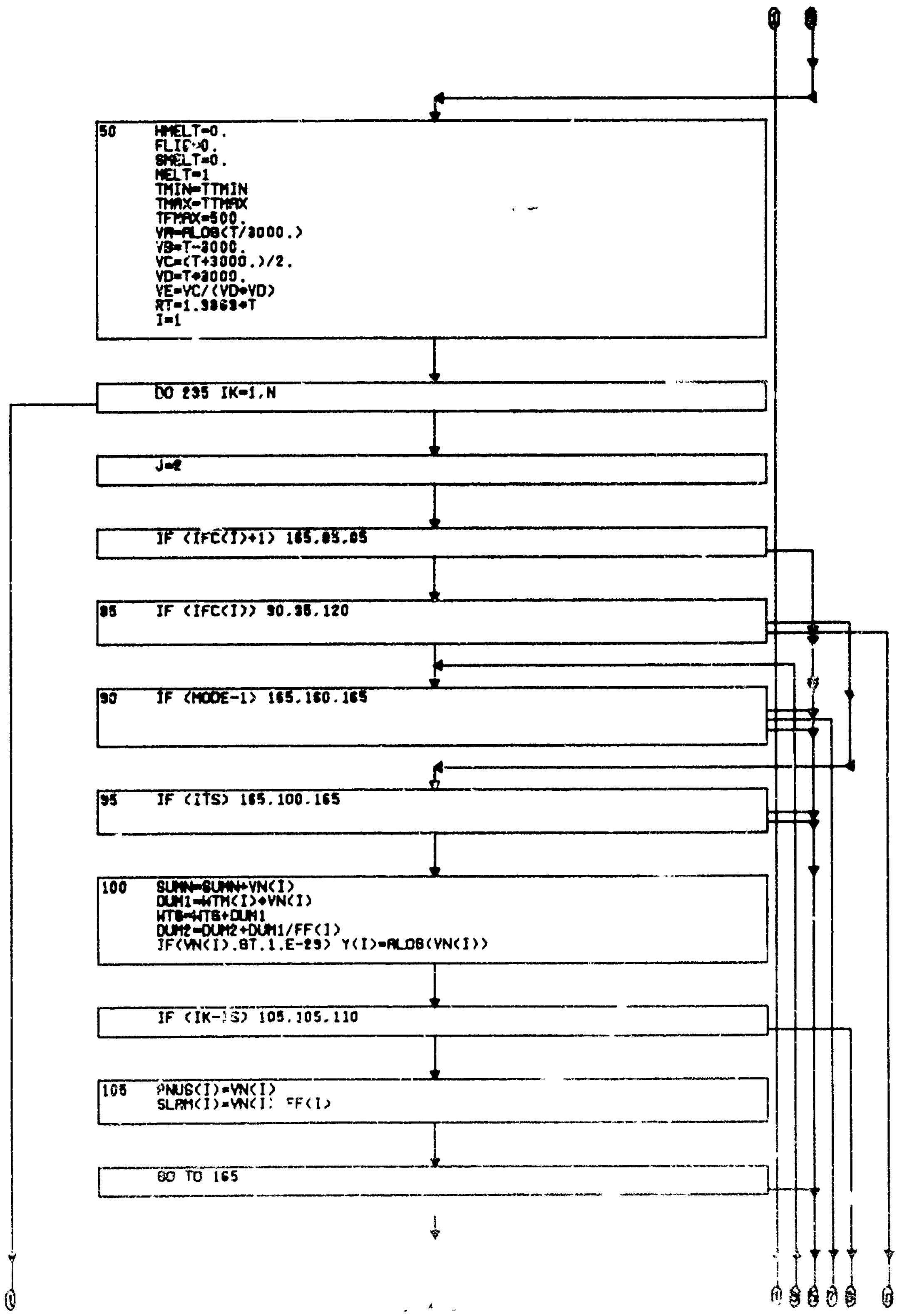
```
      CB21A                                                             B21A 001
            SUBROUTINE THERM                                            B21A 002
            DIMENSION CIJ( 71,1),TF(1)                                  B21A 003*NEW
            EQUIVALENCE(TU( 72),TF),(VNU,CIJ)                           B21A 004*NEW
            COMMON /BLOCOM/FAMOA( 71),FAMOB( 71),N    ,FR( 71,15),W(3),LEF(10)B21A    5*NEW
           1,LEFS(10),PIEASE,LEFW(10)                                   B21A    6*NEW
            COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B21A    7*NEW
           1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B21A    8*NEW
           2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),  B21A    9*NEW
           3 VNU( 71,10),ITFF,KR2,NCH,NCV,WM,WTM( 71,,V( 71),VW( 71),GG( 71)  B21A   10*NEW
           4 ,TQ(10, 7),EPOVRK,SIGMA,2ASMOL                             B21A   11*NEW
            COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,  B21A   12*NEW
           1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPG,  B21A   13*NEW
           2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,MG,  B21A   14*NEW
           3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),  B21A   15*NEW
           4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B21A   16*NEW
           5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),  B21A   17*NEW
           6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)               B21A   18*NEW
            COMMON/INTCOM/KKR(20),KIN,KOUT                                      *-16
      5     MODE=KR(1)                                                      29
            IF (ITS) 50,10,50                                               30
      10    WTG=0.                                                          31
            WTL=0.                                                          32
            IF (KR(8)) 40,40,15                                             33
      15    IF (IFC(N+1)-1) 25,20,25                                        34
      20    IF (T+.001-TF(N+1)) 25,25,30                                    35
      25    IFC(N+1)=-1                                                     36
            VN(N+1)=0.                                                      37
      30    DO 35 K=1,IS                                                    38
         35 VNU(N+1,K)=-TQ(K,L3)
            WTL=-VN(N+1)                                                    40
      40    DUM2=0.                                                         41
            SUMN=0.                                                         42
            DO 45 I=1,IS                                                    43
            PNUS(I)=0.                                                      44
      45    SLAM(I)=0.                                                      45
      50    HMELT=0.                                                        46
            FLIQ=0.                                                         47
            SMELT=0.                                                        48
            MELT=1                                                          49
            TMIN=TTMIN                                                      50
            TMAX=TTMAX                                                      51
            TFMAX=500.                                                      52
            VA=ALOG(T/3000.)                                                53
            VB=T-3000.                                                      54
            VC=(T+3000.)/2.                                                 55
            VD=T*3000.                                                      56
            VE=VC/(VD*VD)                                                   57
            RT=1.9869*T                                                     58
            I=1                                                             66
            DO 235 IK=1,N                                                   67
            J=2                                                             68
            IF (IFC(I)+1) 165,85,85                                         74
      85    IF (IFC(I)) 90,95,120                                           75
      90    IF (MODE-1) 165,160,165                                         76
      95    IF (ITS) 165,100,165                                            77
      100   SUMN=SUMN+VN(I)                                                 78
            DUM1=WTM(I)*VN(I)                                               79
```

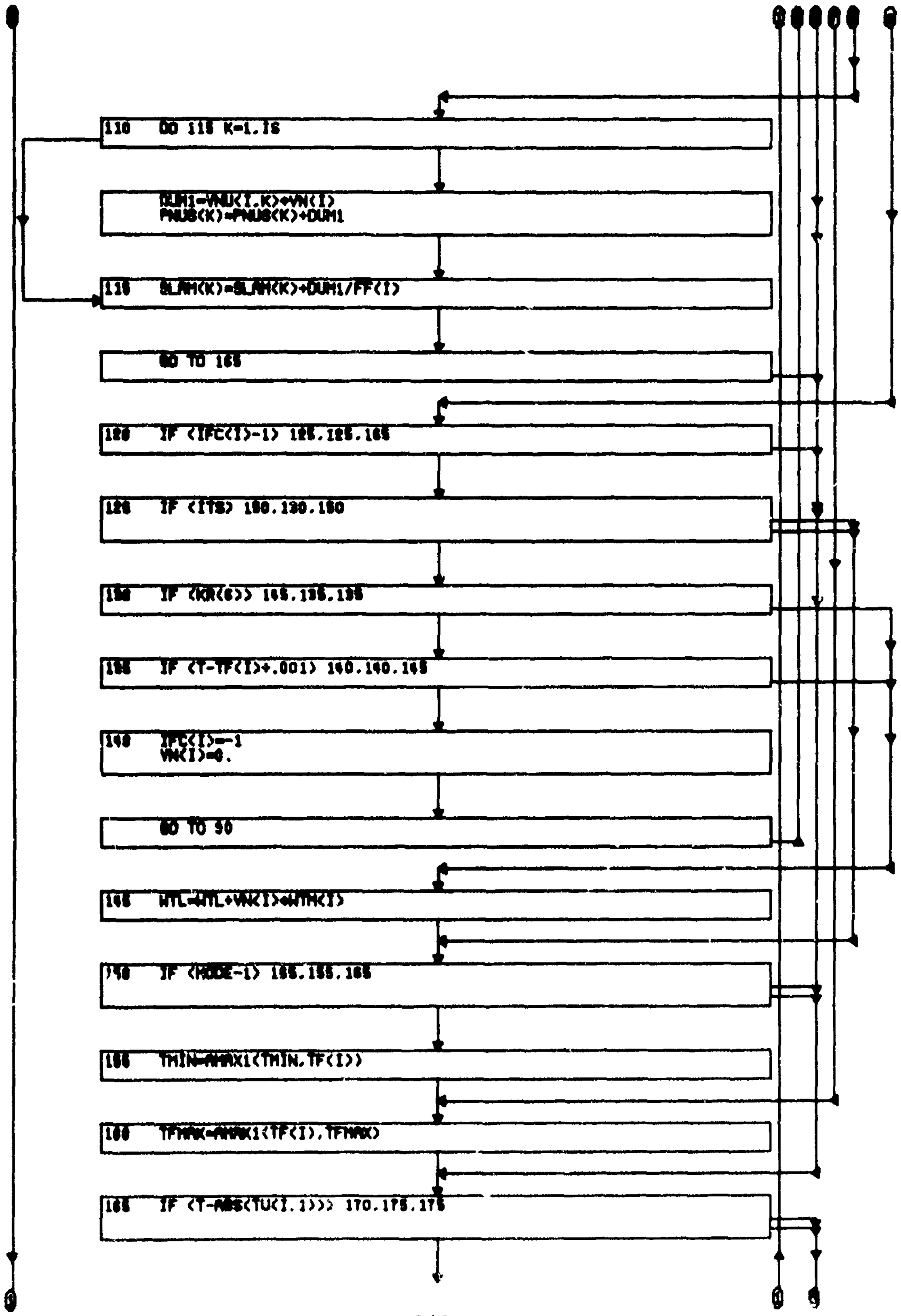
```
      WTG=WTG+DUM1
      DUM2=DUM2+DUM1/FF(I)
      IF(VN(I).GT.1.E-29) Y(I)=ALOG(VN(I))
      IF (IK-IS) 105,105,110
105   PNUS(I)=VN(I)
      SLAM(I)=VN(I)/FF(I)
      GO TO 165
110   DO 115 K=1,IS
      DUM1=VNU(I,K)*VN(I)
      PNUS(K)=PNUS(K)+DUM1
115   SLAM(K)=SLAM(K)+DUM1/FF(I)
      GO TO 165
120   IF (IFC(I)-1) 125,125,165
125   IF (ITS) 150,130,150
130   IF (KR(6)) 145,135,135
135   IF (T-TP(I)+.001) 140,140,145
140   IFC(I)=-1
      VN(I)=0.
      GO TO 90
145   WTL=WTL+VN(I)*WTM(I)
150   IF (MODE-1) 165,155,165
155   TMIN=AMAX1(TMIN,TP(I))
160   TPMAX=AMAX1(TP(I),TPMAX)
165   IF (T-ABS(TU(I,1))) 170,175,175
170   J=1
175   CP(I)=RC(I,J)+T*RD(I,J)+RE(I,J)/(T*T)
      H(I)=RB(I,J)+VB*(RC(I,J)+RD(I,J)*VB-RE(I,J)/VB)
      SS(I)=RF(I,J)+RC(I,J)*VA+VB*(RD(I,J)+RE(I,J)*VE)
      IF (MODE-2) 210,180,180
180   IF (IFC(I)-1) 210,185,210
185   IF (TU(I,1)) 190,210,210
190   IF (T+TJ(I,1)) 200,195,205
195   HMELT=-H(I)+HMELT
      SMELT=-SS(I)+SMELT
      MELT=I
      IF (J-2) 210,170,210
200   TMAX=AMIN1(TMAX,-TU(I,1))
      GO TO 210
205   TMIN=AMAX1(TMIN,-TU(I,1))
210   TC(I)=-H(I)/RT
      VLNK(I)=TC(I)+SS(I)/1.9869
      IF (IK-IS) 215,215,220
215   SLNK(I)=VLNK(I)
      ISC(I)=IFC(I)
      SC(I)=TC(I)
      GO TO 235
220   DO 230 K=1,IS
      IF (ISC(K)+1) 230,225,225
225   VLNK(I)=VLNK(I)-VNU(I,K)*SLNK(K)
      TC(I)=TC(I)-VNU(I,K)*SC(K)
230   CONTINUE
235   I=I+1
      IF (MODE-1) 250,240,250
240   IF (TPMAX-T) 245,250,250
245   T=TPMAX
      IF(T-500.) 248,248,5
  248 WRITE(KOUT,249)
      STOP
  249 FORMAT(///38H NO AVAILABLE SURFACE SPECIES. .   TOP)
250   IF (ITS) 385,255,385
```

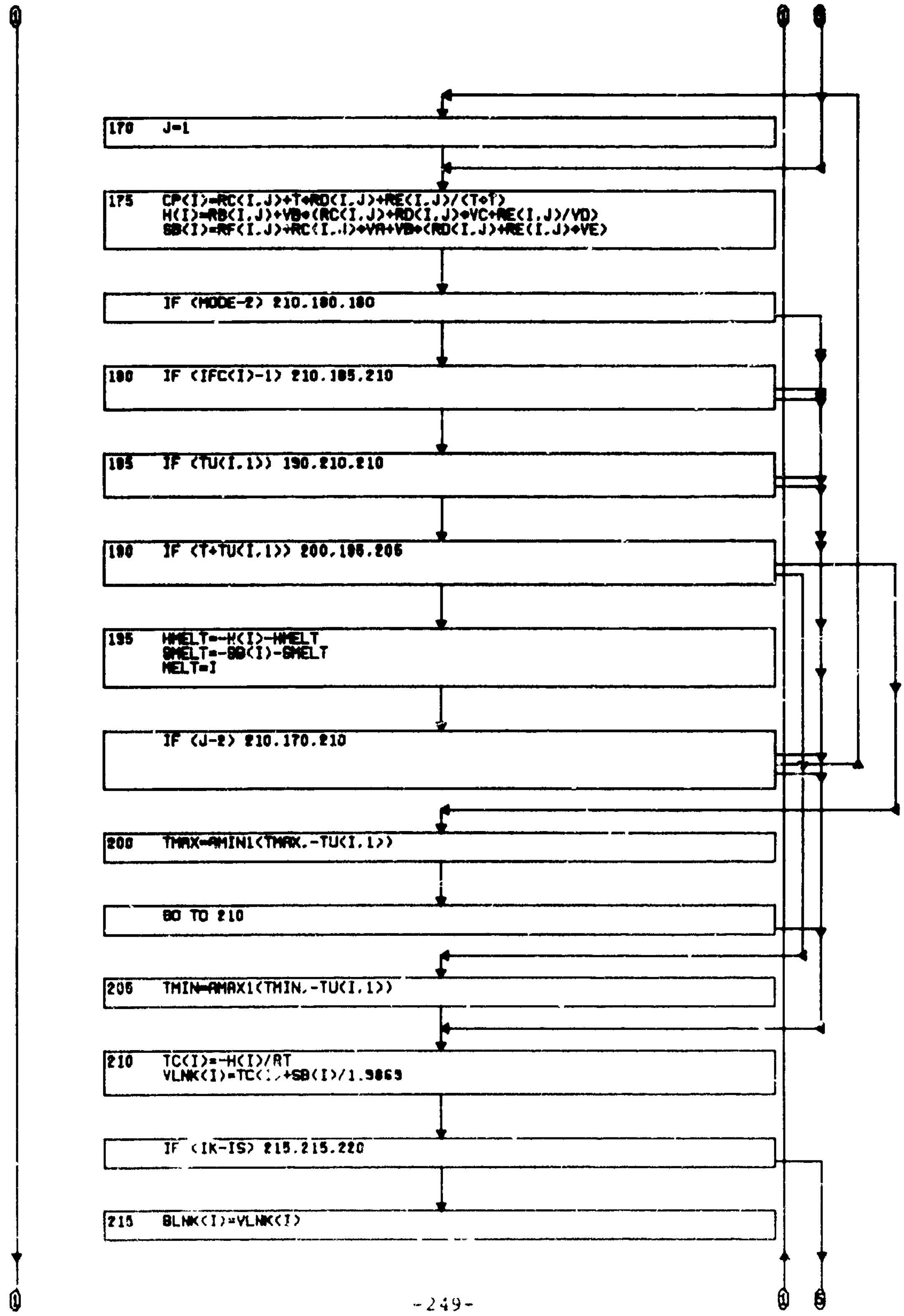
```
 255   AA=P*WM
 365   SUMN=SUMN/P
       SUML=ALOG(SUMN)
       FFF=WTG/DUM2
       WTG=WTG/SUMN
       WTL=WTL/SUMN
       SUMC=1.0
       IF(KR(6)) 385,369,369
   369 DO 370 I=1,18
       PNUS(I)=PNUS(I)/SUMN
 370   SLAM(I)=SLAM(I)/SUMN*FFF
 375   IF (WTL/WTG-WS) 365,385,380
 380   SUMC=WTL/(WTG*WS)
       WTL=WTL/SUMC
 385   RETURN
       END
```

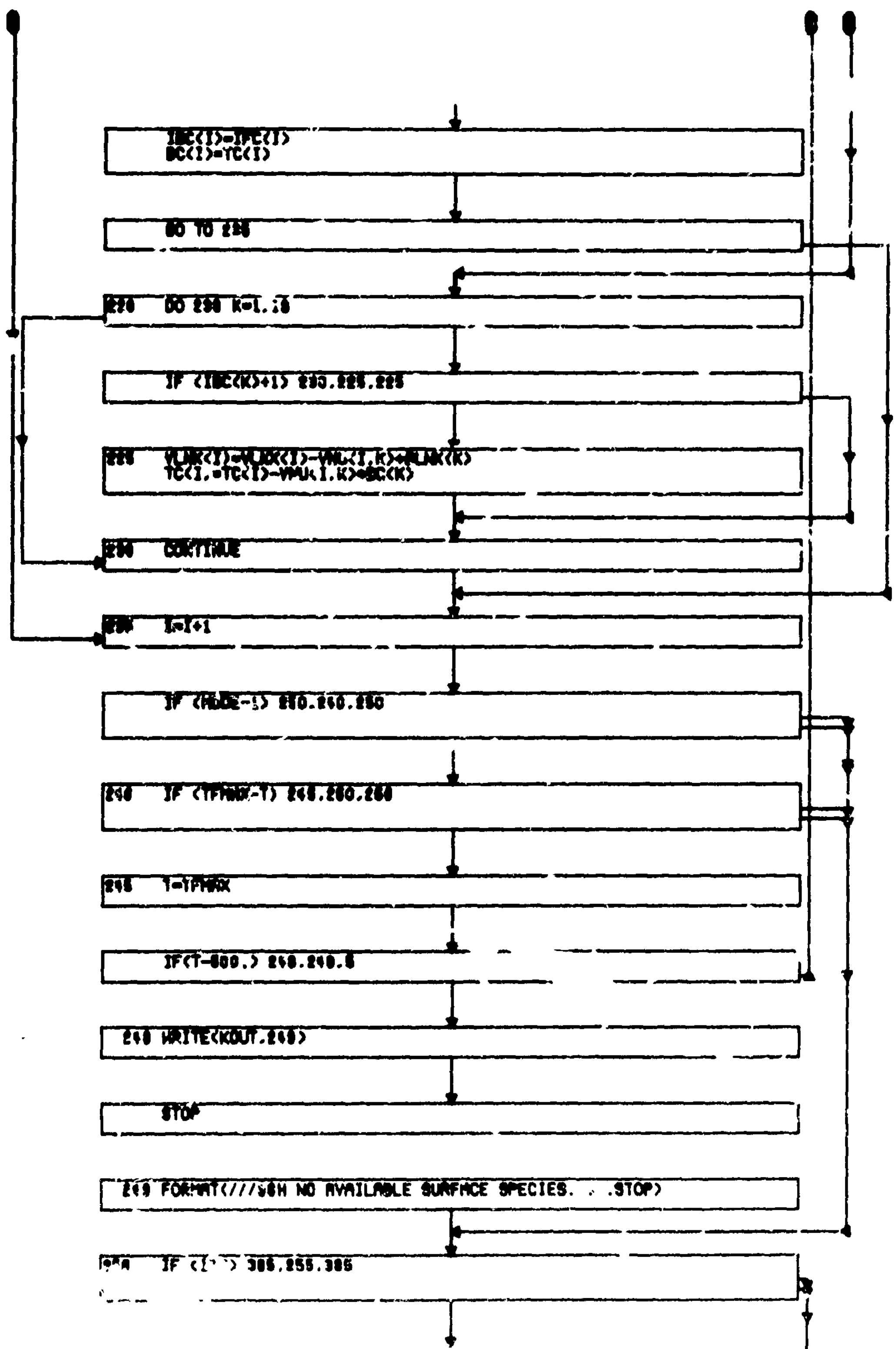
c. Flow Chart

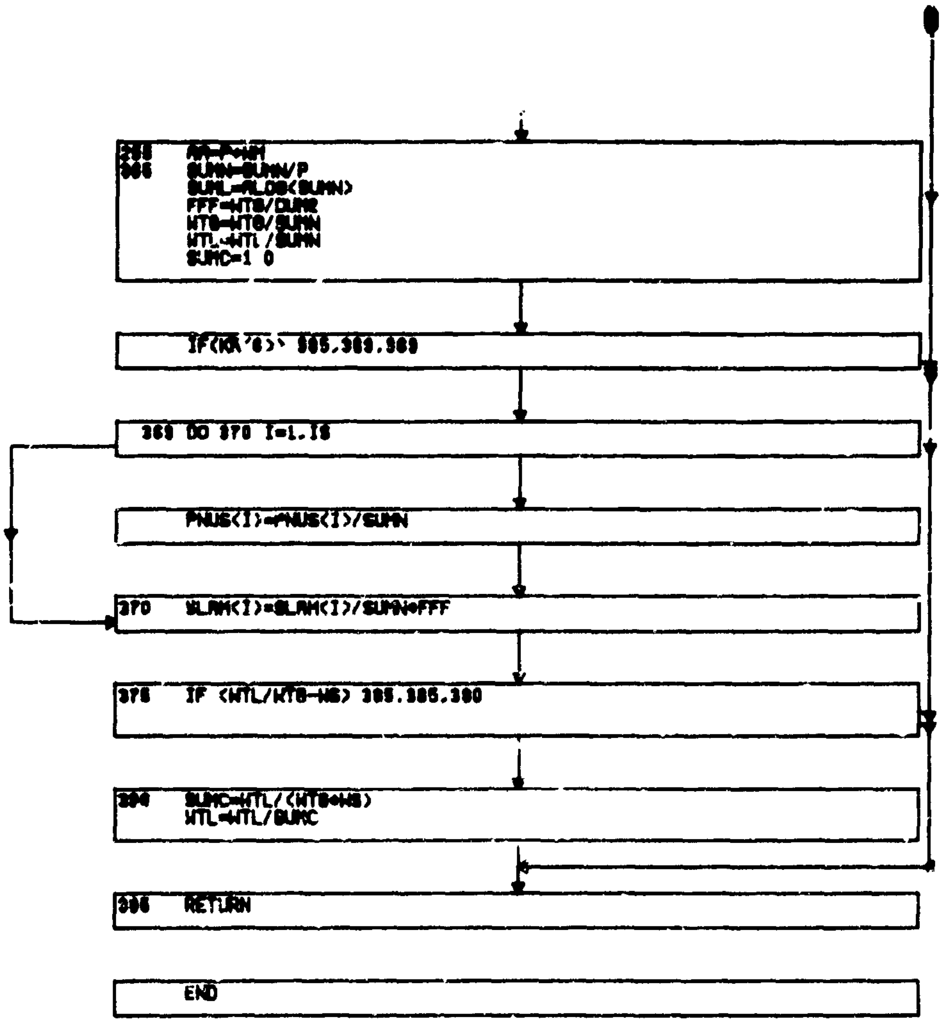

CBE1A
SUBROUTINE THERM
5 MODE=KR(1)
IF (ITS) 50.10.50
10 WTB=0.
WTL=0.
IF (KR(8)) 40.40.15
15 IF (IFC(N+1)-1) 25.20.25
20 IF (T+.001-TF(N+1)) 25.25.30
25 IFC(N+1)=-1
VN(N+1)=0.
30 DO 35 K=1.IS
35 VNU(N+1.K)=-TB(K.L3)
WTL=-VN(N+1)
40 DUM2=0.
SUMN=0.
DO 45 I=1.IS
PNUS(I)=0.
45 SLAM(I)=0.


50 HMELT=0.
FLIQ=0.
SMELT=0.
MELT=1
TMIN=TTMIN
TMAX=TTMAX
TFMAX=500.
VA=ALOG(T/3000.)
VB=T-3000.
VC=(T+3000.)/2.
VD=T*3000.
VE=VC/(VD*VD)
RT=1.9869*T
I=1
DO 235 IK=1,N
J=2
IF (IFC(I)+1) 165,85,85
85 IF (IFC(I)) 90,95,120
90 IF (MODE-1) 165,160,165
95 IF (ITS) 165,100,165
100 SUMN=SUMN+VN(I)
DUM1=WTM(I)*VN(I)
WTS=WTS+DUM1
DUM2=DUM2+DUM1/FF(I)
IF(VN(I).GT.1.E-29) Y(I)=ALOG(VN(I))
IF (IK-IS) 105,105,110
105 PNUS(I)=VN(I)
SLAM(I)=VN(I) FF(I)
GO TO 165


110 DO 115 K=1,IS
DUM1=VNU(I,K)+VN(I)
PNUS(K)=PNUS(K)+DUM1
115 SLAM(K)=SLAM(K)+DUM1/FF(I)
GO TO 165
120 IF (IFC(I)-1) 125,125,165
125 IF (ITS) 150,130,150
130 IF (KR(6)) 165,135,135
135 IF (T-TF(I)+.001) 140,140,165
140 IFC(I)=-1
VN(I)=0.
GO TO 90
145 WTL=WTL+VN(I)*WTH(I)
150 IF (MODE-1) 165,155,165
155 TMIN=AMAX1(TMIN,TF(I))
160 TFMAX=AMAX1(TF(I),TFMAX)
165 IF (T-ABS(TU(I,1))) 170,175,175


170 J=1
175 CP(I)=RC(I.J)+T*RD(I.J)+RE(I.J)/(T*T)
H(I)=RB(I.J)+VB*(RC(I.J)+RD(I.J)*VC+RE(I.J)/VD)
SB(I)=RF(I.J)+RC(I.J)*VA+VB*(RD(I.J)+RE(I.J)*VE)
IF (MODE-2) 210.180.180
180 IF (IFC(I)-1) 210.185,210
185 IF (TU(I.1)) 190.210.210
190 IF (T+TU(I,1)) 200,195,205
195 HMELT=-H(I)-HMELT
SMELT=-SB(I)-SMELT
MELT=I
IF (J-2) 210.170.210
200 TMAX=AMIN1(TMAX.-TU(I.1))
GO TO 210
205 TMIN=AMAX1(TMIN,-TU(I.1))
210 TC(I)=-H(I)/RT
VLNK(I)=TC(I)+SB(I)/1.9865
IF (IK-IS) 215.215.220
215 BLNK(I)=VLNK(I)


IBC(I)=IPC(I)
BC(I)=TC(I)
GO TO 235
220 DO 230 K=1,10
IF (IBC(K)+1) 230,225,225
225 VLNK(I)=VLNK(I)-VNU(I,K)*VLNK(K)
TC(I,=TC(I)-VNU(I,K)*BC(K)
230 CONTINUE
235 I=I+1
IF (MODE-1) 250,240,250
240 IF (TPMAX-T) 245,250,250
245 T=TPMAX
IF(T-800.) 248,248,5
248 WRITE(KOUT,249)
STOP
249 FORMAT(///50H NO AVAILABLE SURFACE SPECIES. . .STOP)
IF (I) 305,255,305


SUMN=SUMN/P
FFF=WTG/DUM2
WTG=WTG/SUMN
WTL=WTL/SUMN
SUMC=1 0
369 DO 370 I=1,IS
PNUS(I)=PNUS(I)/SUMN
370 SLAM(I)=SLAM(I)/SUMN*FFF
375 IF (WTL/WTG-WS) 385,385,380
SUMC=WTL/(WTG*WS)
WTL=WTL/SUMC
385 RETURN
END

23. SUBROUTINE MATER - B22A

a. Function

Evaluates current errors in chemistry solution and sets up matrix of linearized correction equations. Called by EQUIL, calls KINET.

b. Listing

```
      CB22A                                                              B22A 001
            SUBROUTINE MATER                                             B22A 002
            DIMENSION VLAM( 71,1),  X(16)                                B22A 005=NEW
            EQUIVALENCE(AM( 74),VLAM)                                    B22A 006=NEW
            DIMENSION CIJ( 71,1),TF(1)                                   B22A 007=NEW
            DIMENSION ECD( 71)                                           B22A 008=NEW
            EQUIVALENCE(TU( 72),TF),(VNU,CIJ)                            B22A 009=NEW
            COMMON /BLQCOM/FAMOA( 71),FAMOB( 71),N    ,FR( 71,15),W(3),LEF(10)B22A  10=NEW
           1,LEFS(10),PIEASE,LEFW(10)                                    B22A  11=NEW
            COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IXB22A  12=NEW
            COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B22A  13=NEW
           1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B22A  14=NEW
           2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),        B22A  15=NEW
           3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),Y( 71),YW( 71),GG( 71)  B22A  16=NEW
           4 ,TQ(10, 7),EPOVRK,SIGMA,BASMOL                                   B22A  17=NEW
            COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,   B22A  18=NEW
           1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPQ,   B22A  19=NEW
           2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,WG,  B22A  20=NEW
           3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),     B22A  21=NEW
           4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B22A  22=NEW
           5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),        B22A  23=NEW
           6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)                     B22A  24=NEW
            COMMON/KINCOM/MT,FKF(10),EAK(10),EXK(10),PMU(10,10),RMU(10,10),   B22A  25=NEW
           1 DKPT(10),PKP(10),PKR(10),RAT(10),RSIG(10),MA(10),LL(10),PMN(10), B22A  26=NEW
           2 PRMU(10,10),EESE(10)                                             B22A  27=NEW
            COMMON/ ONCOM/AM(153,153),DVNL(153),TCW,                          B22A  28=NEW
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)               B22A  29=NEW
            COMMON/INTCOM/KKR(20),KIN,KOUT                                         =-25
            EQUIVALENCE(B,X)                                             B22A 021
            WSS=W3                                                            28
            DO 5 I=1,IS                                                       29
    5       IBC(I)=IFC(I)                                                     30
            IF(KR(6)) 40,20,20
   20       IF (ITS) 25,40,40                                                 36
   25       DO 35 I=1,IS                                                      37
            IF (IBC(I)-1) 35,30,35                                            38
   30       IBC(I)=-1                                                         39
   35       CONTINUE                                                          40
   40       RV=WSS-WTL/WTG                                                    41
            IF(ITS.EQ.0) RVS =RV
            IF (KR(7)-1) 70,45,50                                             42
   45       IF (ITS) 70,60,70                                                 43
   50       WRITE (KOUT,55) FFF,WTL,WTG,AA,RV,ALP,PNUS,SLAM                   44
   55       FORMAT (32H FFF,WTL,WTG,AA,RV/ALP/PNUS/SLAM/1X5E12.5/(1X10E12.5)) 45
            KR(7)=KR(7)-1                                                     46
            IF (KR(7)-1) 70,60,70                                             47
   60       WRITE (KOUT,65) (I,I=1,IS)                                        48
   65       FORMAT (50H1ITS TEMP   PRES=MWT  EQUIL ER  MASBAL ER  SCALE  7(I3, 49
           17H MASBAL)/90X3(I3,7H MASBAL))                                    50
      C     INITIALIZE                                                        51
   70       EL=0.                                                             52
            CPG=0.                                                            53
            EP=P                                                              54
            CPF=0.                                                            55
            JC=0                                                              56
            JCS=0                                                             57
            ISP=IS+1
            ISPQ=IS+2                                                         58
```

```
      B(1)=0.
      B(2)=0.
      A(1,1)=0.
      A(1,2)=0.
      A(2,1)=0.
      A(2,2)=0.
C     -----INITIALIZE CONTRIBUTION OF MOST SIGNIFICANT SPECIES IN EACH M
      DO 75 I=1,IS
      EB(I)=0.
   75 E(I)=AA*ALP(I)
      ISP2=ISPQ
C     - - - MAIN BASE SPECIES LOOP
      DO 325 IK=1,IS
      I=2+IR(IK)
      IF (KAT(IK)-99) 85,80,85
   80 PNUS(I-2)=0.
C     ZERO MATRIX
   85 DO 90 K=1,ISPQ
   90 A(K,I)=0.
      IF (ITS) 110,95,110
C     NORMALIZE ON PRESSURE ON FIRST PASS
   95 VN(I-2)=VN(I-2)/SUMN
      ECD(I-2)=(1.-EASE)*Y(I-2)
      EBL(I-2)=0.
      IF (IBC(I-2)) 110,100,105
  100 Y(I-2)=Y(I-2)-SUML
      GO TO 110
  105 VN(I-2)=VN(I-2)/SUMC
C     INITIALIZE SOME MORE
  110 B(I)=0.
      A(I,1)=0.
      IP(I-2)=0.
C     SET FLAG INDICATING SIGNIFICANCE OF SPECIES IN MASS
C     BALANCE(S) AND INCREMENT COUNT ON SIGNIFICANT SPECIES
      IF (VN(I-2)-EBL(I-2)) 120,120,115
  115 IP(I-2)=-1
C     TREAT BASE SPECIES CONTAINING BUT NOT REPRESENTING NON-PRESENT
C     ELEMENTS IN SAME MANNER AS NON-PRESENT CONDENSED SPECIES
  120 IF (IBC(I-2)+1) 325,125,125
  125 IF (IBC(I-2)) 180,215,130
  130 A(I,I)=1.
      VA=VN(I-2)
      IF (IABS(IBC(I-2)-3)-1) 135,280,140
  135 A(2,I)=1.0
      GO TO 280
  140 IF (EB(I-2)-ABS(VA)) 145,150,150
  145 EB(I-2)=ABS(VA)
      IB(I-2)=I-2
  150 E(I-2)=E(I-2)-VA
      IF (KR(6)) 155,160,160
  155 IF (MODE-1) 260,170,260
  160 DO 165 K=1,IS
  165 A(K+2,I)=-WTM(I-2)*(PNUS(K)/WTG+GAMF(K))
      A(I,I)=A(I,I)+1.
  170 TMIN=AMAX1(TMIN,TF(I-2))
      IF (T-TF(I-2)+.001) 175,175,180
  175 A(I,I)=1.0E+10
      E(I-2)=-VN(I-2)*1.001E+10
      MODE=0
  180 IF (MODE-1) 185,190,185
```

```
185   IF (KR(8)) 280,280,190
190   IF (TF(I-2)+.001-T) 325,195,195
195   IF (JC) 205,205,200
200   IF (Y(I-2)-BJC) 325,325,205
  205 BJC=Y(I-2)-ECD(I-2)
      JCS=JC
      TMAX=TF(I-2)
      JC=I-2
      IFCJC=IBC(I-2)
      IF (KR(8)) 210,210,280
210   A(1,JCS+2)=0.
      A(1,I)=-1.0
      B(1)=BJC
      GO TO 325
C     -----GAS PHASE
215   VA=VN(I-2)
      CPG=CPG+VA*CP(I-2)
      A(1,I)=VA
      A(2,I)=VA
      EP=EP-VA
      IF (KAT(IK)-99) 220,275,220
220   IF (KR(6)) 275,250,225
225   DO 230 K=1,IS
  230 A(K+2,I)=(VLAM(I-2,K)+GAMH(K)*H(I-2))*VA
      A(I,I)=A(I,I)+VA*RV
      DUM2=WTM(I-2)/WTG*WTL/WTG*VA
      DO 245 K=1,IS
      IF (EB(K)-ABS(A(K+2,I))) 235,240,240
235   EB(K)=ABS(A(K+2,I))
      IB(K)=I-2
240   E(K)=E(K)-A(K+2,I)
245   A(K+2,I)=A(K+2,I)+DUM2*PNUS(K)
      GO TO 280
250   DUM1=WTM(I-2)/WTG*VA
      DUM2=WTL/WTG*DUM1
      IF (KR(4)) 255,255,260
255   DUM1=0.
      VA=(RV+1.)*VA
      GO TO 265
260   DUM1=DUM1*(1.-FFF/FF(I-2))
      VA=(RV+FFF/FF(I-2))*VA
265   DO 270 K=1,IS
270   A(K+2,I)=DUM1*SLAM(K)+DUM2*PNUS(K)
      A(I,I)=A(I,I)+VA
275   EB(I-2)=ABS(VA)
      IB(I-2)=I-2
      E(I-2)=E(I-2)-VA
280   IF (MODE-2) 320,300,285
285   IF (IBC(I-2)) 325,295,290
290   HOS=SB(I-2)
      GO TO 305
295   HOS=SB(I-2)-1.9869*Y(I-2)-1.98
      GO TO 310
300   HOS=H(I-2)
      IF (IBC(I-2)) 325,310,305
305   A(1,I)=HOS
      GO TO 315
310   A(1,I)=HOS*VN(I-2)
315   A(2,I)=A(2,I)+HOS*VN(I-2)
320   CPF=CPF+CP(I-2)*VN(I-2)
```

```
  325   CONTINUE
        DO 330 I=1,IS
        BE(I)=E(I)
  330   BY(I)=Y(I)
        IER=0
        IRE=0
        EER=0.
C       - - - MAIN NON-BASE SPECIES LOOP
  350   LIM=N+KR(8)
        IF (LIM-ISP) 730,355,355
  355   J=ISP
        DO 725 IK=ISP,LIM
        IF (IK-N) 365,365,360
  360   E(J)=1.E-10
        IF (IFC(J)) 410,725,445
  365   IF (IFC(J)+1) 725,370,370
  370   IF (ITS) 390,375,390
  375   VN(J)=VN(J)/SUMN
        IF (IFC(J)) 390,385,380
  380   VN(J)=VN(J)/SUMC
        GO TO 390
  385   Y(J)=Y(J)-SUML
  390   E(J)=VLNK(J)-Y(J)
        DO 405 I=1,IS
        IF (IBC(I)) 400,400,395
  395   FNU(I)=0.
        GO TO 405
  400   FNU(I)=VNU(J,I)
        E(J)=E(J)+FNU(I)*BY(I)
  405   CONTINUE
        IF(KR(6)) 409,409,406
   406  IF(ITS) 408,407,408
   407  ECD(J)=(1.-EASE)*E(J)
   408  E(J)=E(J)-ECD(J)
   409  EAB=ABS(E(J))
        IF (IFC(J)) 410,390,445
C       CONDENSED SPECIES
  410   EAB=E(J)
        IF (KR(6)) 425,415,415
  415   IF (T-TF(J)+.001) 420,425,425
  420   EAB=0.
        IF (KR(8)) 535,535,545
  425   IF (E(J)-EER) 535,535,430
  430   EER=E(J)
        IF (IER) 435,435,440
  435   ISPG=ISPG+1
        IER=ISPG
  440   IE=IER
        IRE=IK
        GO TO 450
  445   ISPG=ISPG+1
        IE=ISPG
  450   YTR=0.
        IF (KR(6)) 460,455,455
  455   TMIN=AMAX1(TF(J),TMIN)
        YTR=TF(J)/WTC
  460   DO 465 I=1,ISPG
        A(I,IE)=0.
  465   A(IE,I)=0.
        DO 480 K=1,IS
```

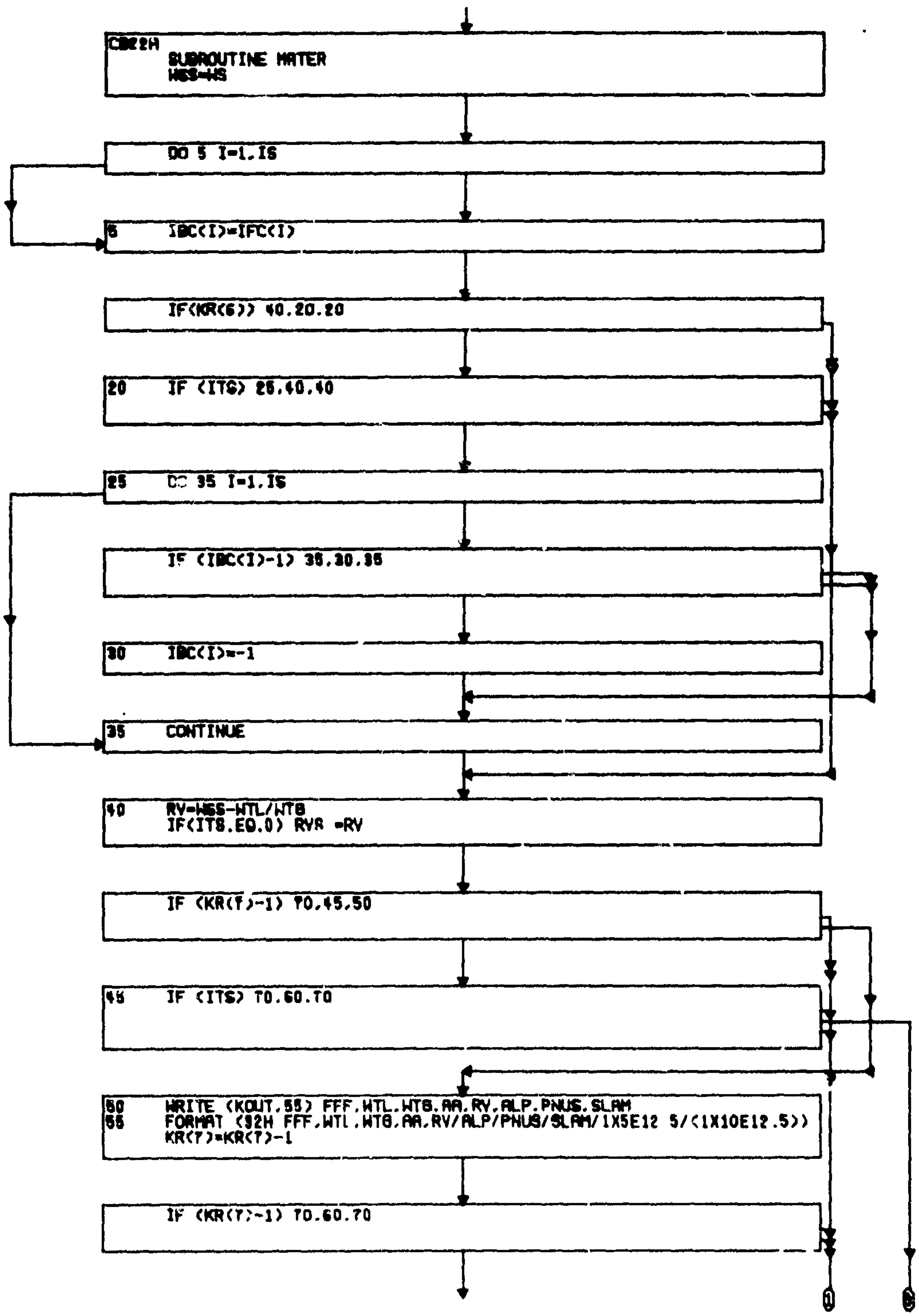
```
      DUM1=VNU(J,K)
      IF (IBC(K)-1) 470,470,480
470   VA=DUM1*VN(J)
      A(K+2,IE)=DUM1-WTR*(PNUS(K)+GAMF(K)*WTG)
      BE(K)=BE(K)-VA
      IF (ABS(VA)-EB(K)) 480,480,475
475   EB(K)=ABS(VA)
      IB(K)=IK
480   CONTINUE
      K=IE-ISP2
      IF (IK-N) 505,505,485
485   JJ(K)=JC
      B(IE)=Y(JC)
      IF (JC-IS) 495,495,490
490   A(IE,1)=TC(JC)
      B(IE)=E(JC)
495   EAB=-B(IE)
      IF (IFCJC) 715,715,500
500   EAB=ABS(EAB)
      GO TO 715
505   JJ(K)=J
      A(IE,1)=TC(J)
      B(IE)=E(J)
      IF (T+.001-TF(J)) 515,510,510
510   IF (KR(8)) 530,530,540
515   IF (MODE-1) 520,525,520
520   IF (KR(6)) 530,525,525
525   A(IE,IE)=1.E+10
      B(IE)=-VN(J)*1.001E+10
      MODE=0
530   IF (MODE-2) 535,575,580
535   IF (MODE-1) 715,540,715
540   IF (T-TF(J)-.001) 545,545,560
545   IF (JC) 555,555,550
550   IF (E(J)-BJC) 725,725,555
555   BJC=E(J)
      JC=IK
      IFCJC=IFC(JC)
      TMAX=TF(J)
      IF (KR(8)) 565,565,560
560   IF (MODE-2) 725,575,580
565   B(1)=BJC
      DO 570 K=1,IS
570   A(1,K+2)=-FNU(K)
      A(1,1)=TC(J)
      GO TO 725
575   HOS=H(J)
      GO TO 585
580   HOS=SB(J)
585   A(1,IE)=HOS
      A(1,2)=A(1,2)-VN(J)*HOS
      CPF=CPF+CP(J)*VN(J)
      GO TO 715
C     GAS PHASE SPECIES
590   IP(J)=0
      IF (VN(J)) 595,715,595
595   IQ=0
      CPG=CPG+VN(J)*CP(J)
      IF (KR(6)) 625,600,605
600   FFJ=FFF/FF(J)
```

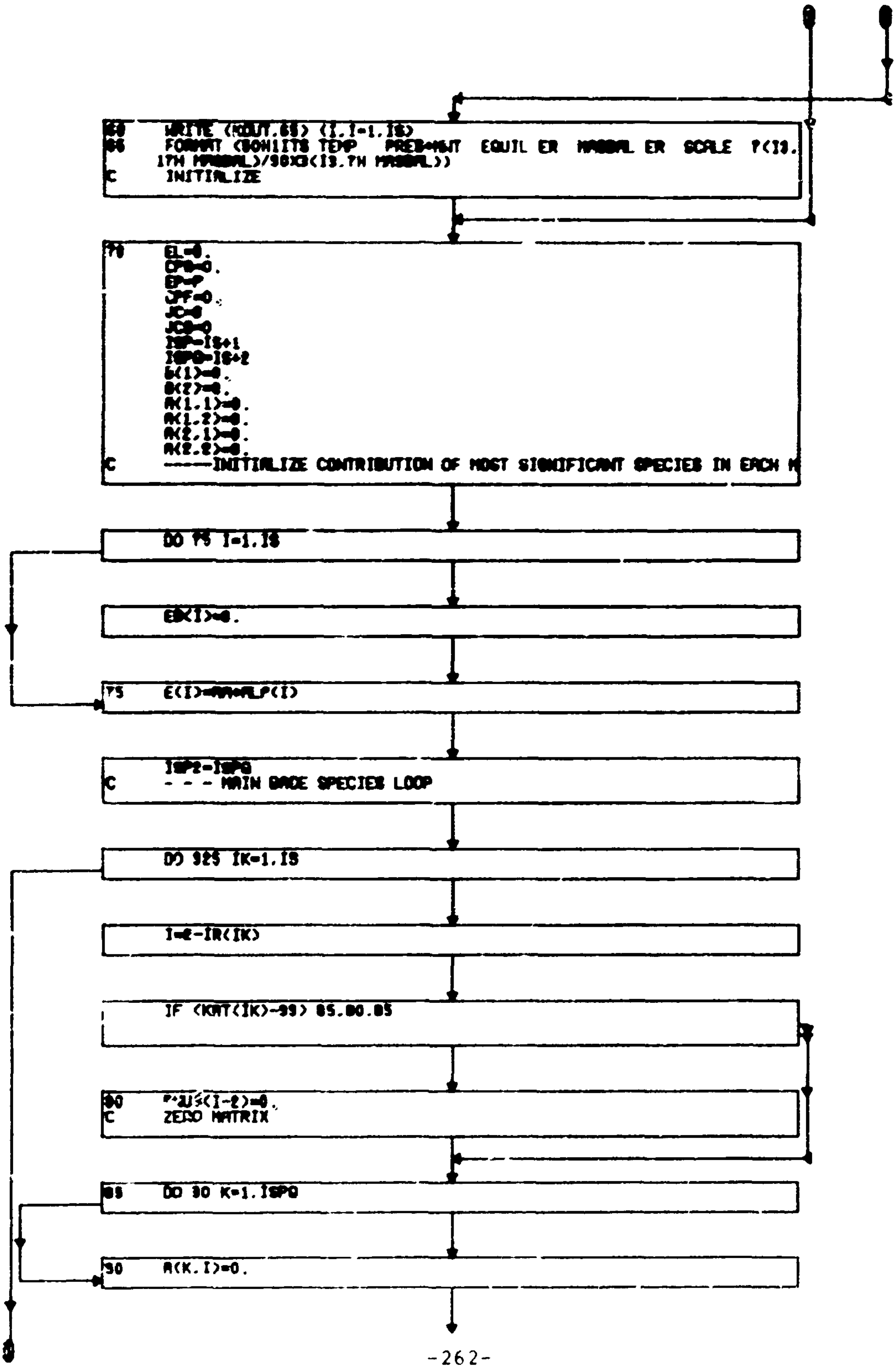
```
605   DUM1=WTM(J)/WTG*VN(J)
      DUM2=DUM1/WTG*WTL
      IF (KR(6)) 610,610,625
610   IF (KR(4)) 615,615,620
615   DUM1=0.
      FFJ=1.0
      GO TO 625
620   DUM1=DUM1*(1.-FFJ)
625   DO 680 KI=1,IS
      I=2-IR(KI)
      VA=VNU(J,I-2)*VN(J)
      IF (KAT(KI)-99) 630,645,630
630   IF (KR(6)) 645,640,635
635   VA=VA*RV+VN(J)*(VLAM(J,I-2)+GAMH(I-2)*H(J))
      BE(I-2)=BE(I-2)-VA
      ABSVA=ABS(VA)
      VA=VA+PNUS(I-2)*DUM2
      GO TO 650
640   VB=VA*FFJ
      VA=RV*VA+VB
      BE(I-2)=BE(I-2)-VA
      ABSVA=ABS(VA)
      VA=VA+BLAM(I-2)*DUM1+DUM2*PNUS(I-2)
      GO TO 650
645   BE(I-2)=BE(I-2)-VA
      ABSVA=ABS(VA)
650   IF (ABSVA-EBL(I-2)) 660,660,655
655   IQ=1
      IF (ABSVA-EB(I-2)) 670,670,665
660   IF (ABS(VA)-EBL(I-2)) 680,680,670
665   EB(I-2)=ABSVA
      IR(I-2)=IK
670   DO 675 K=3,ISP2
675   A(I,K)=A(I,K)+VA*FNU(K-2)
      B(I)=B(I)-VA*E(J)
      A(I,1)=A(I,1)-VA*TC(J)
      A(2,I)=A(2,I)+VN(J)*PNU(I-2)
680   CONTINUE
      IF (IQ) 715,715,685
685   EP=EP-VN(J)
      IP(J)=-1
      B(2)=B(2)-VN(J)*E(J)
      A(2,1)=A(2,1)-VN(J)*TC(J)
      IF (MODE-2) 710,690,695
690   HOS=H(J)*VN(J)
      GO TO 700
695   HOS=VN(J)*(SB(J)-1.9869*Y(J)-1.9869)
700   DO 705 I=3,ISP2
705   A(1,I)=HOS*FNU(I-2)+A(1,I)
      A(1,2)=A(1,2)-HOS
      A(1,1)=A(1,1)-HOS*TC(J)
      B(1)=B(1)-HOS*E(J)
710   CPF=CPF+VN(J)*CP(J)
715   IF (EL-EAB) 720,725,725
720   EL=EAB
725   J=J+1
730   CONTINUE
      ISP3=IS+3
      IF (MODE-2) 785,735,760
735   CPA=CPF*T
```

```
        SHMLT=HMELT*VN(MELT)
        EHS=AA*HIF+A(1,2)
        IF (KKJ+1) 750,740,750
  740   DUM1=SVA/AA*T*T
        EHS=AA*SVC-DUM1+A(1,2)
        HIP=-A(1,2)/AA
        A(1,2)=-AA*SVC-DUM1
        CPA=(CPF+2.*DUM1/T)*T
        DUM2=SVB/AA*T
        P=P-EP
        EP=0.
        IF (ABS(EHS/AA)-10.) 745,745,750
  745   EP=-P+SVD-DUM2
        A(2,1)=A(2,1)+DUM2
        A(2,2)=-DUM2
  750   IF (KR(2)-MODE) 765,755,765
  755   A(1,2)=-AA*HIP
        GO TO 765
  760   CPA=CPF
        SHMLT=SMELT*VN(MELT)
        EHS=AA*SIP+A(1,2)-1.9869*(P-EP)
        A(1,2)=-AA*SIP
  765   B(1)=B(1)+EHS
        A(1,1)=A(1,1)+CPA
        IF (SHMLT) 785,785,770
  770   IF (EHS) 785,785,775
  775   EHS=EHS-SHMLT
        B(1)=B(1)-SHMLT
        IF (EHS) 780,785,785
  780   FLIQ=1.+EHS/SHMLT
        MODE=0
        A(1,1)=1.E+10
        TMIN=500.
        TMAX=5000.
  785   ENL=ABS(EP)/P*100.
        DO 810 I=3,ISP2
        E(I-2)=BE(I-2)
        EBL(I-2)=EB(I-2)*1.E-7
        A(I,2)=-AA*ALP(I-2)
        IF (IFC(I-2)-1) 795,795,790
  790   NFM=NFM+1
        GO TO 810
  795   IF (KR(6)) 805,805,800
  800   A(I,1)=A(I,1)+GAMH(I-2)*T*CPG
        E(I-2)=E(I-2)+WTL*GAMF(I-2)
  805   ER=E(I-2)
        ABER=ABS(ER)/(EB(I-2)+1.E-20)
        ENL=AMAX1(ABER,ENL)
        B(I)=B(I)+ER
  810   CONTINUE
        IF (ISP2-ISPQ) 815,880,880
  815   IV=0
        JZ=0
C       ADD CONDENSED NONBASE SPECIES TO ARRAY
        DO 840 IE=ISP3,ISPQ
        J=IE-ISP2
        J=JJ(J)
        IF (J-IS) 820,820,830
  820   DO 825 K=1,IS
  825   A(IE,K+2)=0.
```

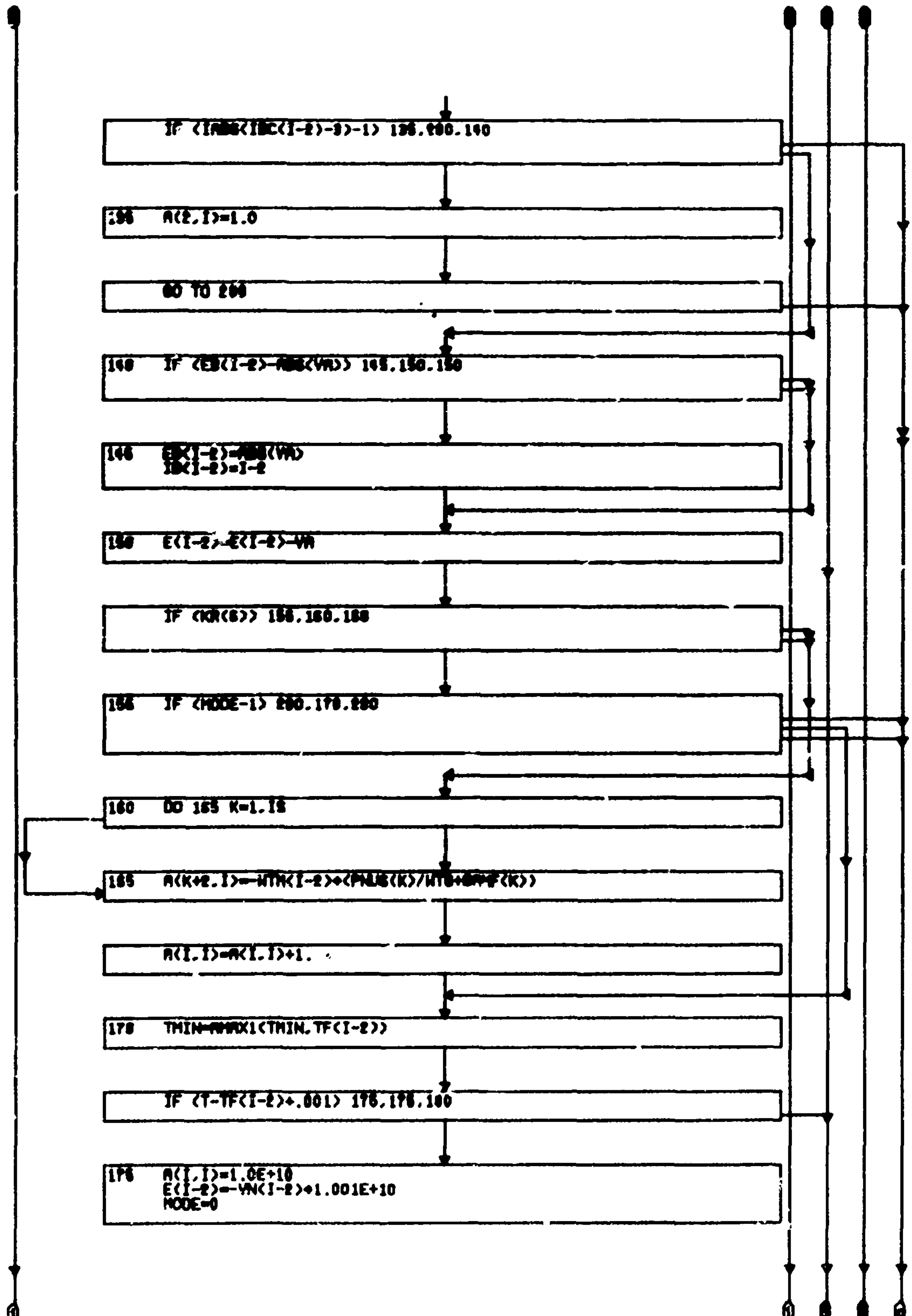
```
      A(IE,J+2)=-1.0                                              93
      GO TO 840                                                   94
830   DO 835 K=1,IS                                               95
835   A(IE,K+2)=-VNU(J,K)                                         96
840   CONTINUE                                                    97
C     ELIMINATE TERMS CORRESPONDING TO PRESENT BASE CONDENSED     98
      DO 855 K=1,IS                                               99
      IF (IFC(K)) 855,855,845                                    100
845   DO 850 IE=ISP3,ISPQ                                        101
850   A(IE,K+2)=0.                                               102
855   CONTINUE                                                   103
880   B(2)=EP+B(2)                                               111
      IF(KR(6)) 5979,5979,5976
 5976 ENL=ABS(EP)/P*100.
      IF(MT) 5973,5973,5974
 5974 CALL KINET
 5973 CONTINUE
      DO 5975 I=1,IS
      IF(EB(I)) 5986,5986,5985
 5985 EB(I)=AMAX1(EB(I),ABS(E(I)))
      IF(ITS) 5978,5977,5978
 5977 EESE(I)=E(I)*(1.-EASE)
 5978 E(I)=E(I)-EESE(I)
      B(I+2)=B(I+2)-EESE(I)
 5986 EB(I)=ABS(EB(I))
      IF(IFC(I)-1) 5971,5971,5975
 5971 ENL=AMAX1(ENL,ABS(E(I)/(EB(I)+1.E-20)))
 5975 CONTINUE
 5979 CONTINUE
      IF (MODE-1) 910,890,885                                    1'
885   IF (ABS(EHB/A(1,1))-.0001) 910,910,920
890   IF (IFCJC) 895,900,905                                     1 .
895   IF (JC-IRE) 900,905,900                                    1'5
905   MODE=0                                                     117
      TMIN=TTMIN                                                 118
      TMAX=TTMAX                                                 119
900   IF (ABS(B(1))-1.E-4) 910,910,920                           116
910   IF (EL-1.E-4) 915,915,920                                  121
915   IF (ENL-1.E-5) 935,935,920                                 122
920   IN=ISPQ                                                    123
      IL=1                                                       124
      IF (MODE) 925,925,930                                      125
925   IN=ISPQ-1                                                  126
      IL=2                                                       127
      X(1)=0.                                                    128
930   RETURN                                                     129
935   IT=ITS+1                                                   130
      ITS=-1
      GO TO 930                                                  132
      END                                                        133
```

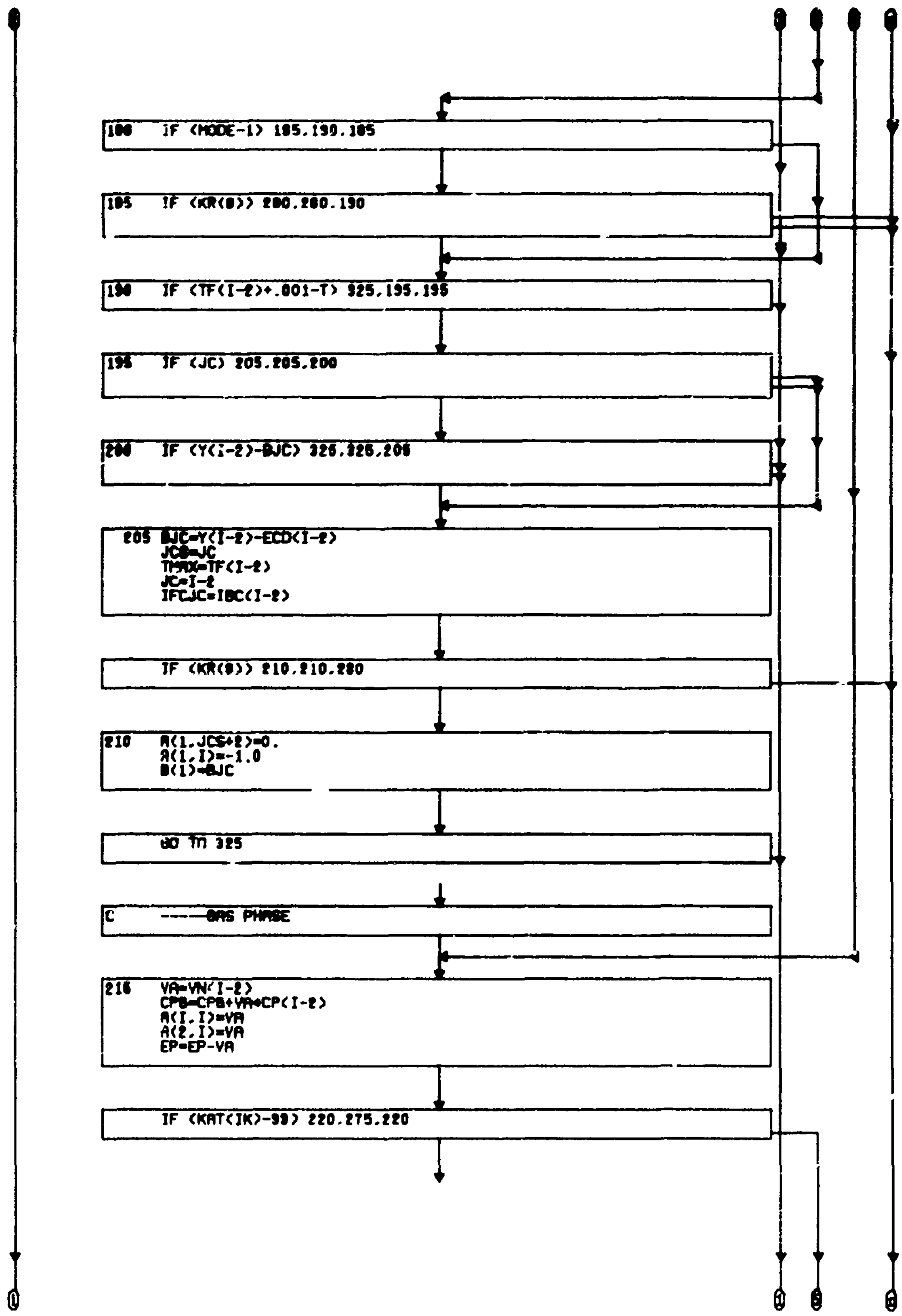
c. Flow Chart

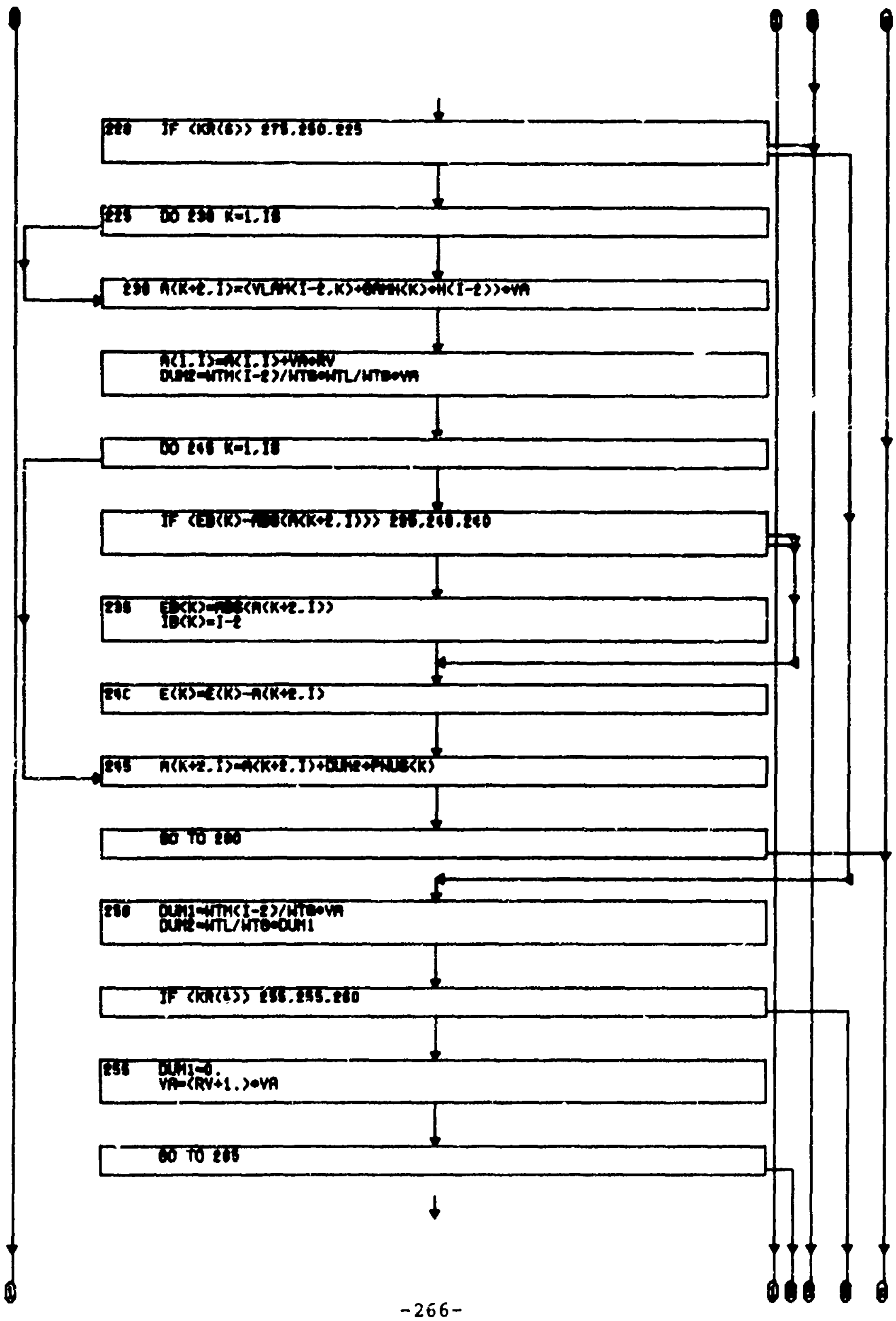

CB22H
SUBROUTINE MATER
WSS=WS
DO 5 I=1,IS
5 IBC(I)=IFC(I)
IF(KR(6)) 40,20,20
20 IF (ITS) 25,40,40
25 DO 35 I=1,IS
IF (IBC(I)-1) 35,30,35
30 IBC(I)=-1
35 CONTINUE
40 RV=WSS-WTL/WTB
IF(ITS.EQ.0) RVR =RV
IF (KR(7)-1) 70,45,50
45 IF (ITS) 70,60,70
50 WRITE (KOUT,55) FFF,WTL,WTB,AA,RV,ALP,PNUS,SLAM
55 FORMAT (32H FFF,WTL,WTB,AA,RV/ALP/PNUS/SLAM/1X5E12 5/(1X10E12.5))
KR(7)=KR(7)-1
IF (KR(7)-1) 70,60,70
1
2

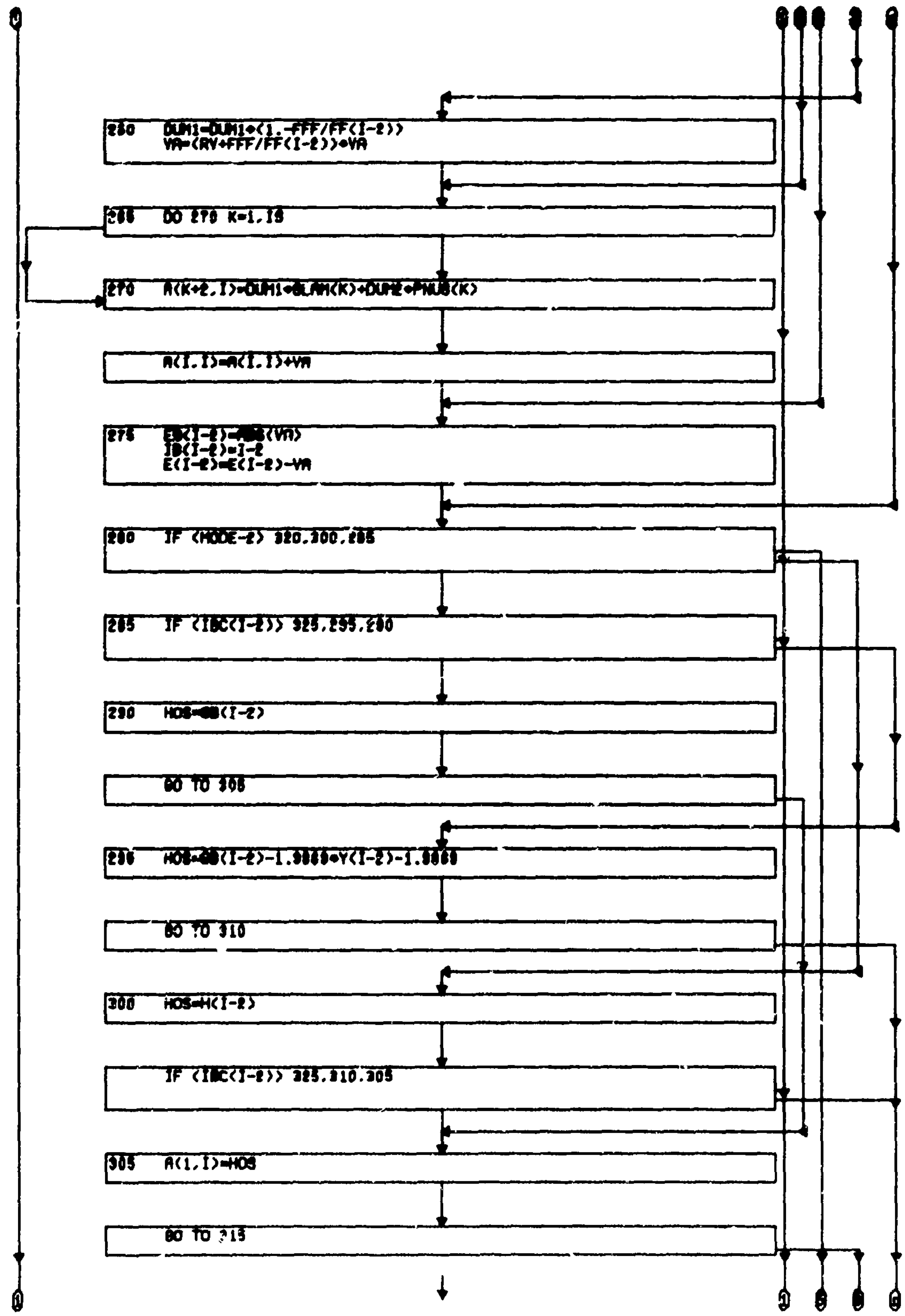

WRITE (KOUT,65) (I,I=1,IS)
INITIALIZE
EL=0.
EP=P
JPF=0.
JC=0
A(1,1)=0.
A(1,2)=0.
A(2,1)=0.
A(2,2)=0.
C ----INITIALIZE CONTRIBUTION OF MOST SIGNIFICANT SPECIES IN EACH
DO 75 I=1,IS
75 E(I)
C - - - MAIN BASE SPECIES LOOP
DO 325 IK=1,IS
I=2-IR(IK)
IF (KAT(IK)-99) 85,80,85
C ZERO MATRIX
85 DO 80 K=1,ISPQ
80 A(K,I)=0.

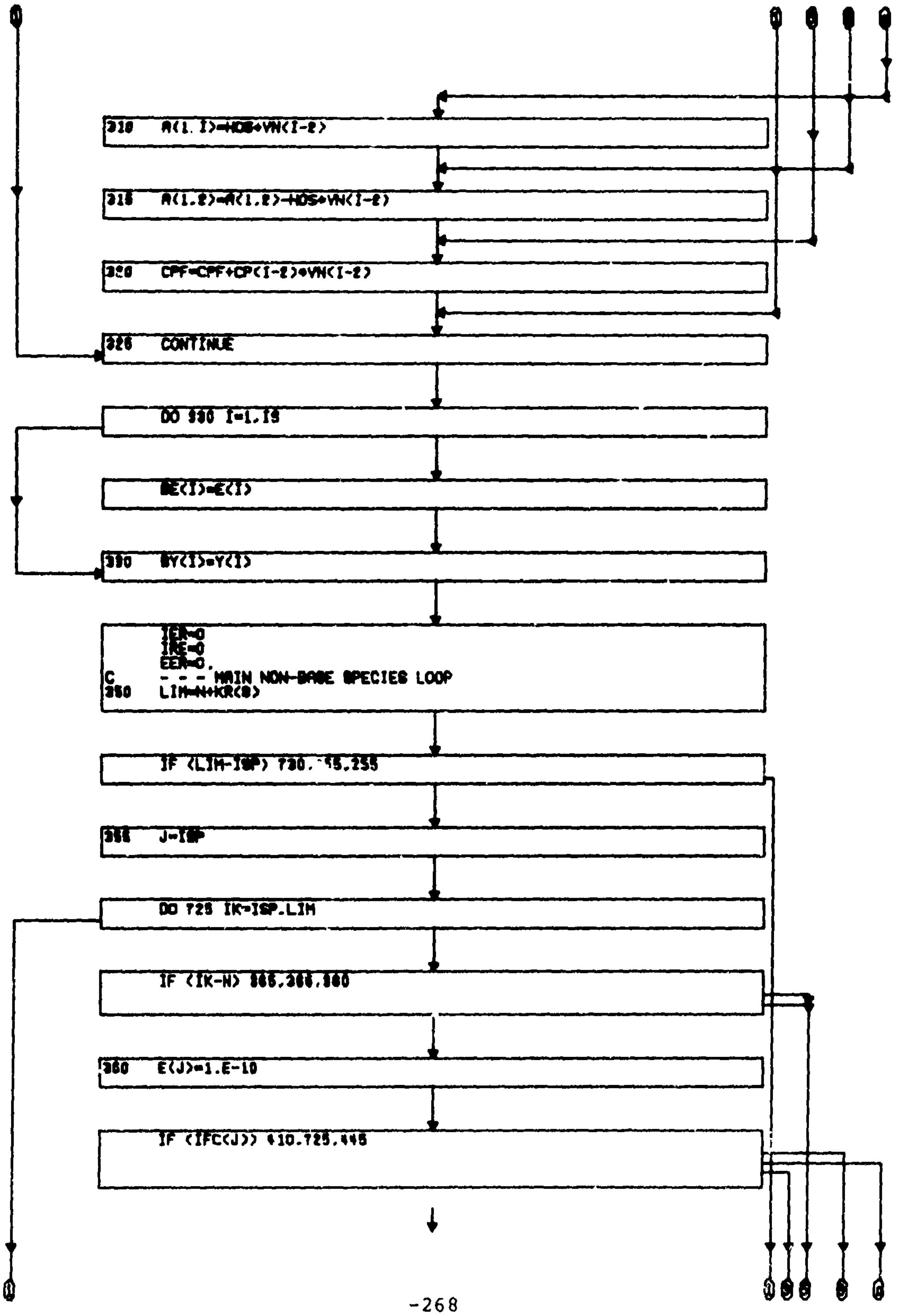
```
      IF (ITS) 110,95,110
C     NORMALIZE ON PRESSURE ON FIRST PASS
95    VN(I-2)=VN(I-2)/SUMN
      ECD(I-2)=(1.-EBGE)*Y(I-2)
      EBL(I-2)=0.
      IF (IBC(I-2)) 110,100,105
100   Y(I-2)=Y(I-2)-SUML
      GO TO 110
105   VN(I-2)=VN(I-2)/SUMC
C     INITIALIZE SOME MORE
110   B(I)=0.
      A(I,1)=0.
      IP(I-2)=0.
C     SET FLAG INDICATING SIGNIFICANCE OF SPECIES IN MASS
C     BALANCE(S) AND INCREMENT COUNT ON SIGNIFICANT SPECIES
      IF (VN(I-2)-EBL(I-2)) 120,120,115
115   IP(I-2)=-1
C     TREAT BASE SPECIES CONTAINING BUT NOT REPRESENTING NON-PRESENT
C     ELEMENTS IN SAME MANNER AS NON-PRESENT CONDENSED SPECIES
120   IF (IBC(I-2)+1) 325,125,125
125   IF (IBC(I-2)) 180,215,130
130   A(I,I)=1.
      VA=VN(I-2)
```

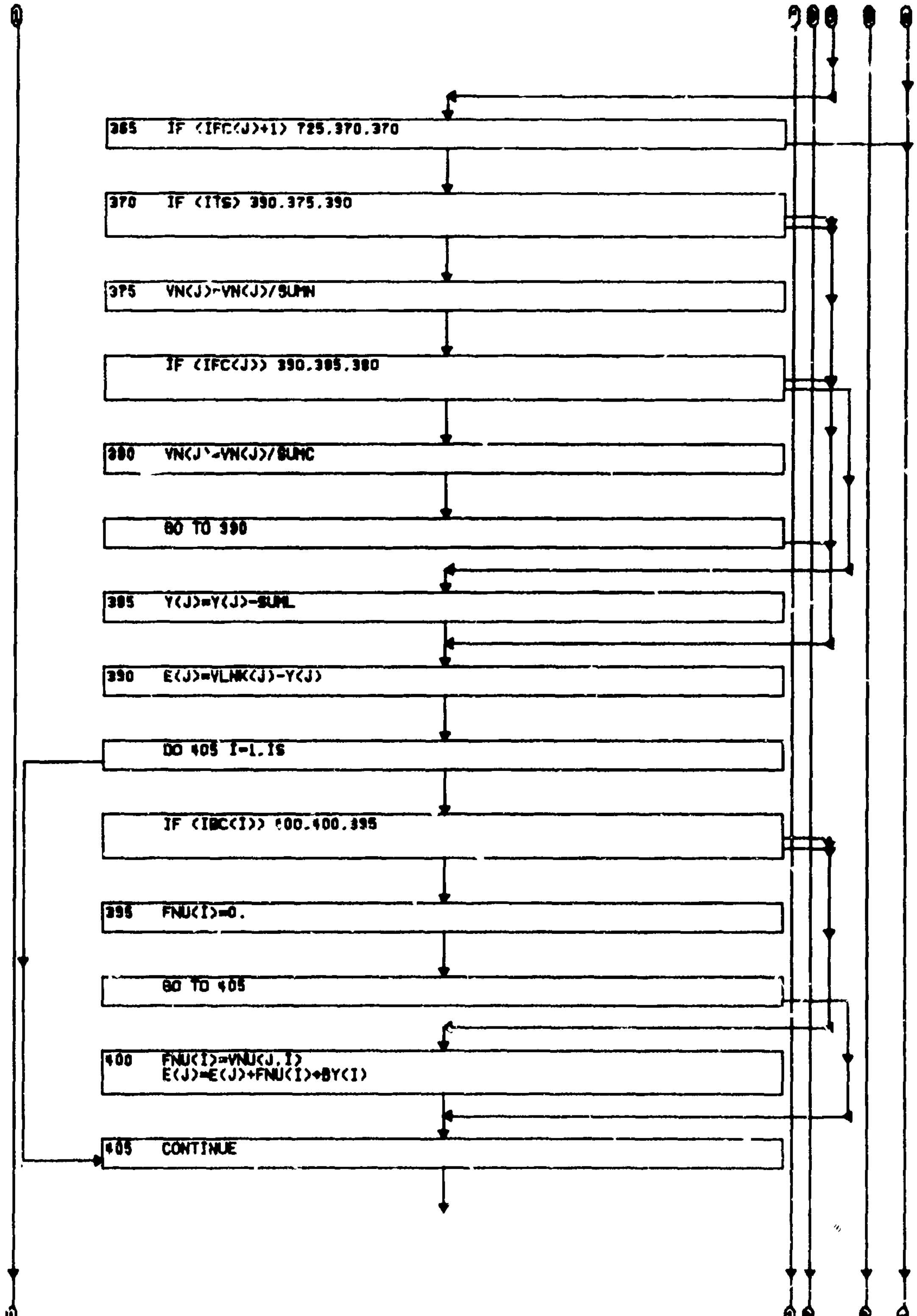

A(2,I)=1.0
GO TO 200
IF (KR(6)) 155,160,180
155 IF (MODE-1) 200,170,200
160 DO 165 K=1,IS
A(I,I)=A(I,I)+1.
IF (T-TF(I-2)+.001) 175,175,180
A(I,I)=1.0E+10
E(I-2)=-VN(I-2)+1.001E+10
MODE=0

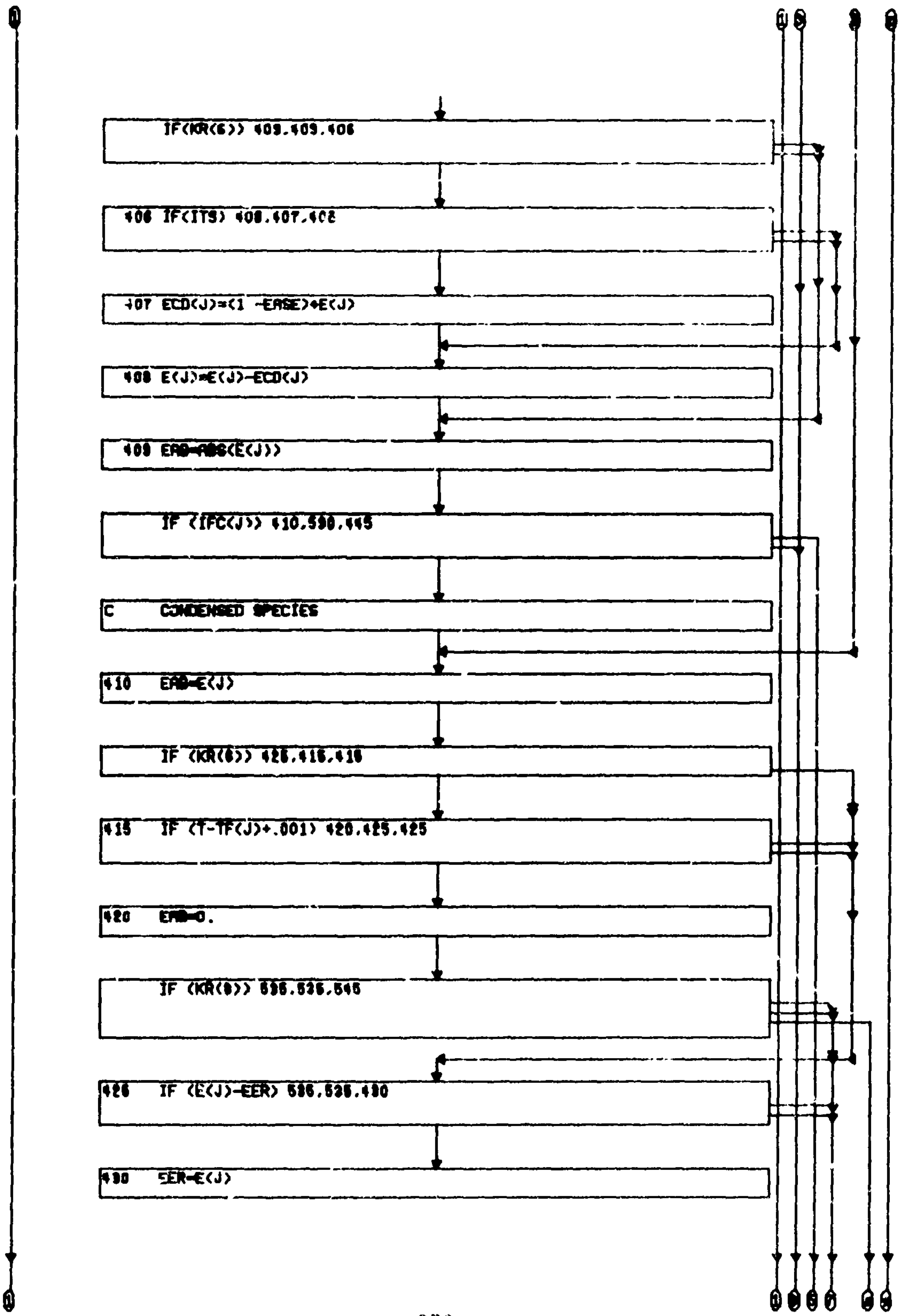

180 IF (MODE-1) 185.190.185
185 IF (KR(8)) 280.280.190
190 IF (TF(I-2)+.001-T) 325.195.195
195 IF (JC) 205.205.200
200 IF (Y(I-2)-BJC) 325.325.205
205 BJC=Y(I-2)-ECD(I-2)
JCS=JC
TMAX=TF(I-2)
JC=I-2
IFCJC=IBC(I-2)
IF (KR(8)) 210.210.280
210 A(1.JCS+2)=0.
A(1.I)=-1.0
B(1)=BJC
GO TO 325
C -----GAS PHASE
215 VA=VN(I-2)
CPB=CPB+VA*CP(I-2)
A(I.I)=VA
A(2.I)=VA
EP=EP-VA
IF (KAT(IK)-99) 220.275.220

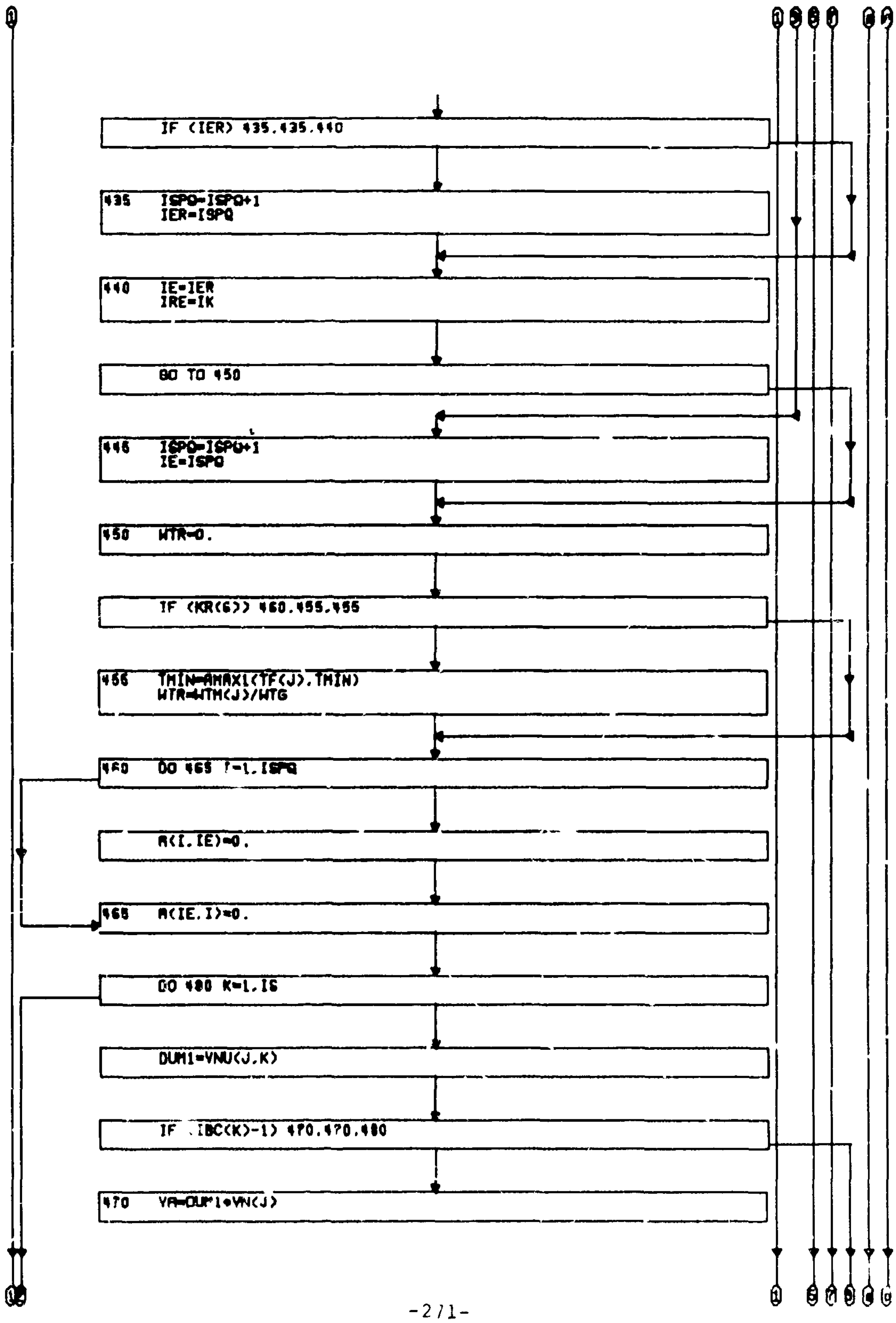

220 IF (KR(6)) 275.250.225
225 DO 230 K=1,IS
230 A(K+2.I)=(VLAM(I-2.K)+GAMMA(K)*H(I-2))*VA
A(I.I)=A(I.I)+VA*RV
DUM2=WTM(I-2)/WTB*WTL/WTB*VA
DO 245 K=1,IS
IF (EB(K)-ABS(A(K+2.I))) 235.240.240
235 EB(K)=ABS(A(K+2.I))
IB(K)=I-2
240 E(K)=E(K)-A(K+2.I)
245 A(K+2.I)=A(K+2.I)+DUM2*PNUB(K)
GO TO 280
250 DUM1=WTM(I-2)/WTB*VA
DUM2=WTL/WTB*DUM1
IF (KR(4)) 255.255.260
255 DUM1=0.
VA=(RV+1.)*VA
GO TO 265

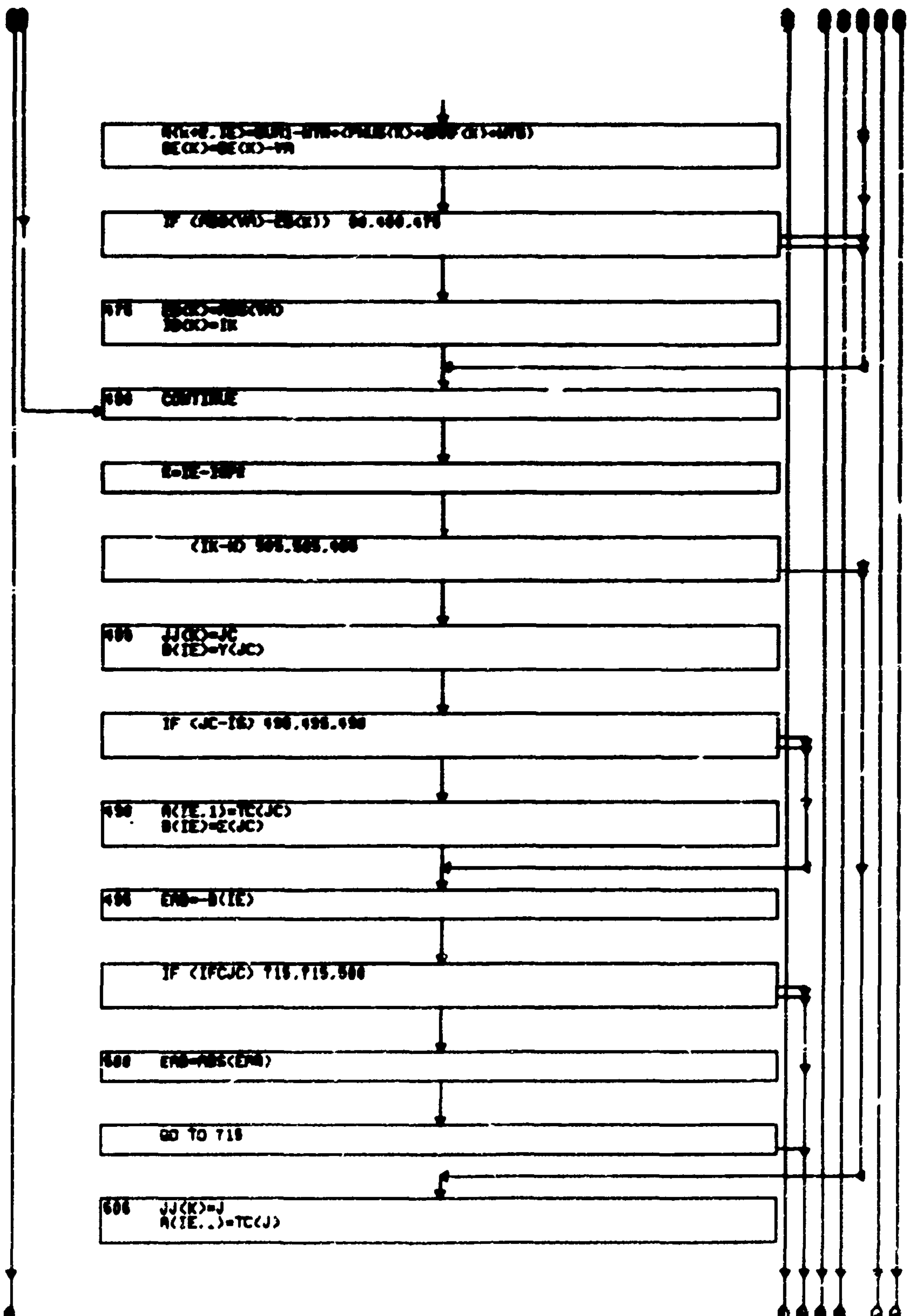

260 DUM1=DUM1+(1.-FFF/FF(I-2))
VA=(RV+FFF/FF(I-2))*VA
265 DO 270 K=1,IS
270 A(K+2,I)=DUM1*SLAM(K)+DUM2*PNUS(K)
A(I,I)=A(I,I)+VA
275 EB(I-2)=ABS(VA)
IB(I-2)=I-2
E(I-2)=E(I-2)-VA
280 IF (MODE-2) 320,300,285
285 IF (IBC(I-2)) 325,295,290
290 HOS=GB(I-2)
GO TO 305
295 HOS=GB(I-2)-1.3869*Y(I-2)-1.3869
GO TO 310
300 HOS=H(I-2)
IF (IBC(I-2)) 325,310,305
305 A(1,I)=HOS
GO TO 315


310 A(1,I)=HOS*VN(I-2)
315 A(1,2)=A(1,2)-HOS*VN(I-2)
320 CPF=CPF+CP(I-2)*VN(I-2)
325 CONTINUE
DO 330 I=1,IS
SE(I)=E(I)
330 SY(I)=Y(I)
IER=0
IRE=0
EER=0.
C - - - MAIN NON-BASE SPECIES LOOP
350 LIM=N+KR(8)
IF (LIM-ISP) 730, 55,255
355 J=ISP
DO 725 IK=ISP,LIM
IF (IK-N) 365,365,360
360 E(J)=1.E-10
IF (IFC(J)) 410,725,445

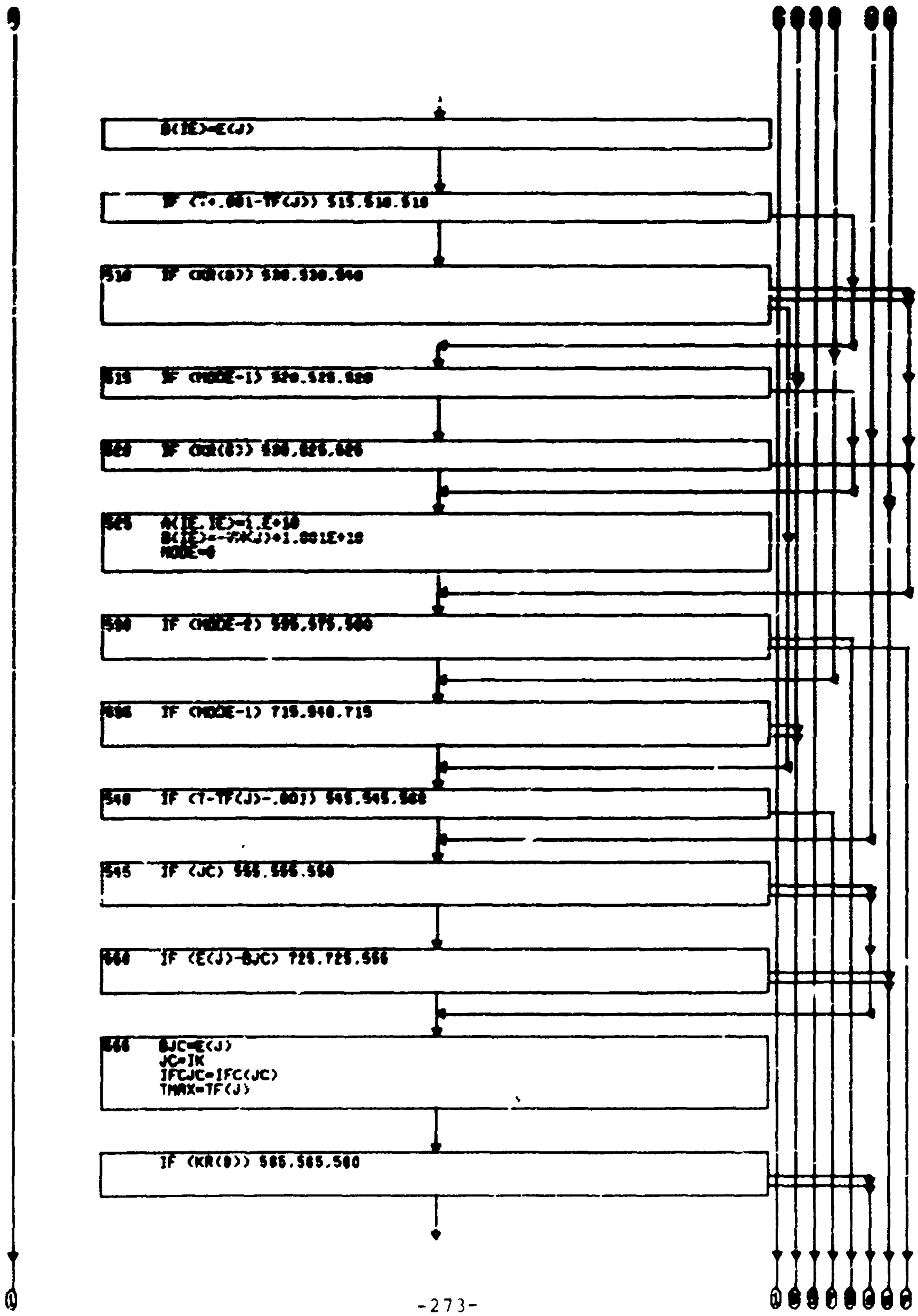

365 IF (IFC(J)+1) 725.370.370
370 IF (ITS) 390.375.390
375 VN(J)=VN(J)/SUMN
IF (IFC(J)) 390.385.380
380 VN(J)=VN(J)/SUMC
GO TO 390
385 Y(J)=Y(J)-SUML
390 E(J)=VLNK(J)-Y(J)
DO 405 I=1.IS
IF (IBC(I)) 400.400.395
395 FNU(I)=0.
GO TO 405
400 FNU(I)=VNU(J.I)
E(J)=E(J)+FNU(I)*BY(I)
405 CONTINUE

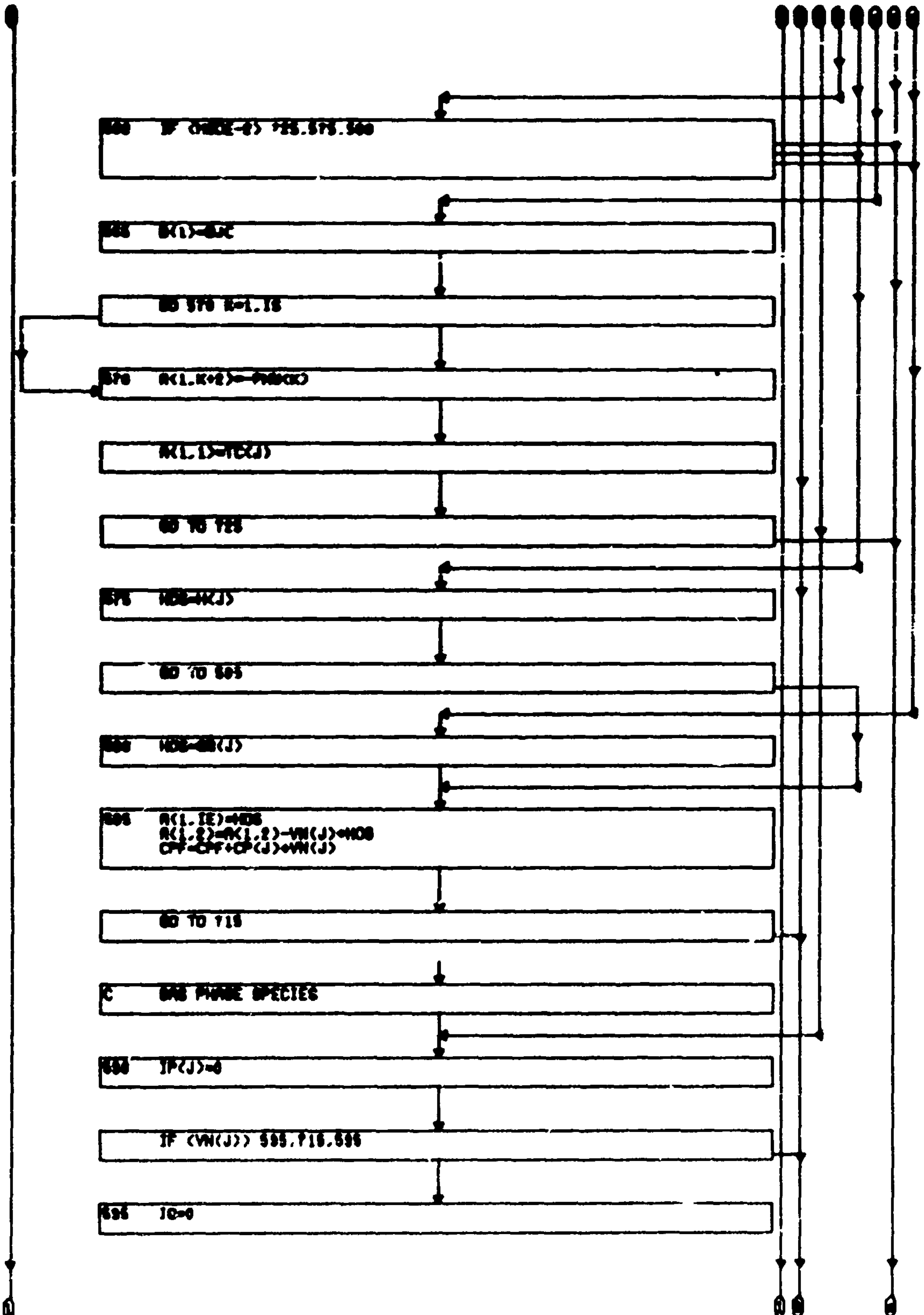

IF(KR(6)) 409.409.406
406 IF(ITS) 408.407.408
407 ECD(J)=(1 -EASE)*E(J)
408 E(J)=E(J)-ECD(J)
409 EAB=ABS(E(J))
IF (IFC(J)) 410.590.445
C CONDENSED SPECIES
410 EAB=E(J)
IF (KR(8)) 425.415.415
415 IF (T-TF(J)+.001) 420.425.425
420 EAB=0.
IF (KR(8)) 535.535.545
425 IF (E(J)-EER) 535.535.430
430 EER=E(J)

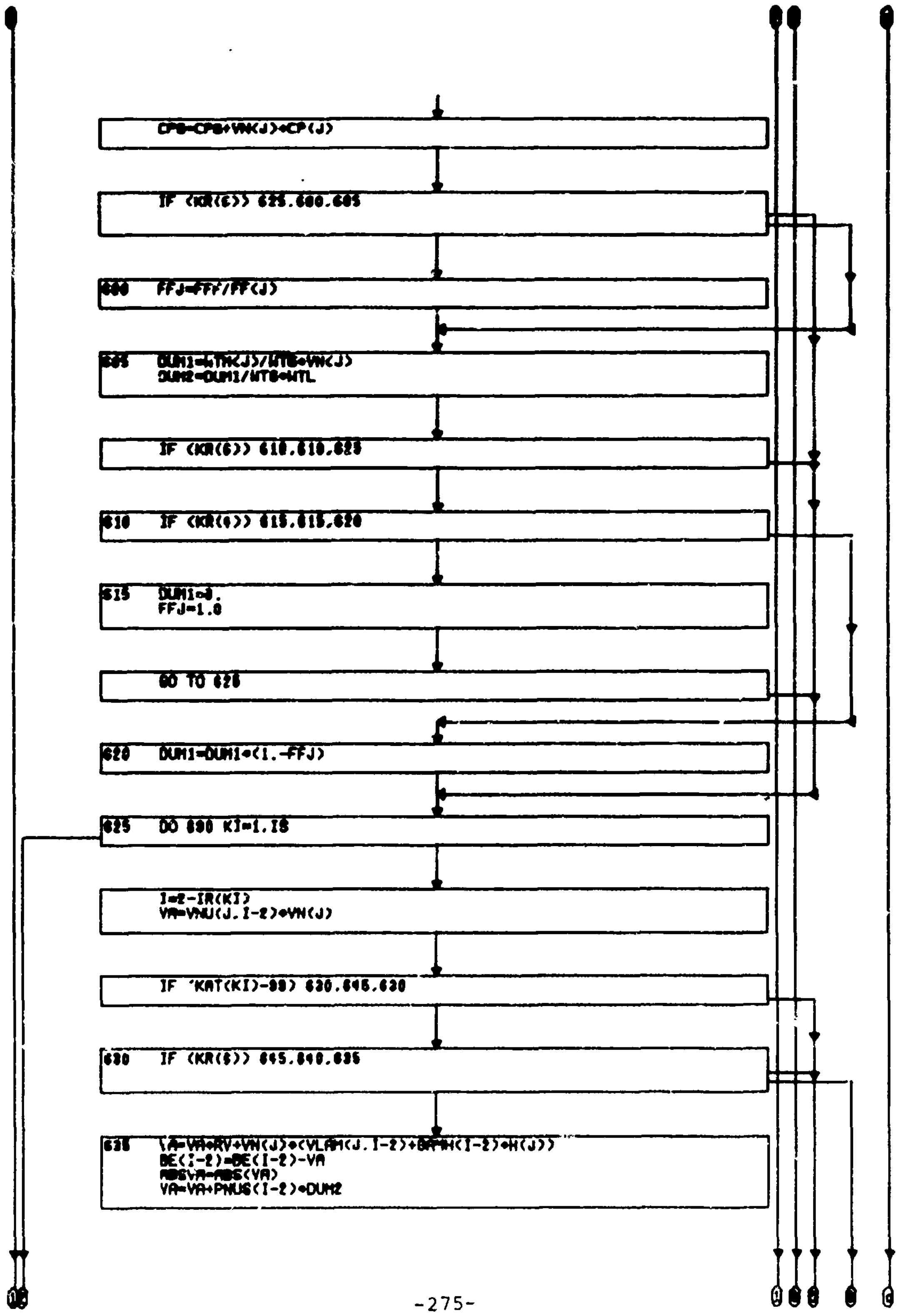

IF (IER) 435,435,440
435 ISPQ=ISPQ+1
IER=ISPQ
440 IE=IER
IRE=IK
GO TO 450
445 ISPQ=ISPQ+1
IE=ISPQ
450 WTR=0.
IF (KR(6)) 460,455,455
455 TMIN=AMAX1(TF(J),TMIN)
WTR=WTM(J)/WTG
460 DO 465 I=1,ISPQ
A(I,IE)=0.
465 A(IE,I)=0.
DO 480 K=1,IS
DUM1=VNU(J,K)
IF (IBC(K)-1) 470,470,480
470 VA=DUM1*VN(J)

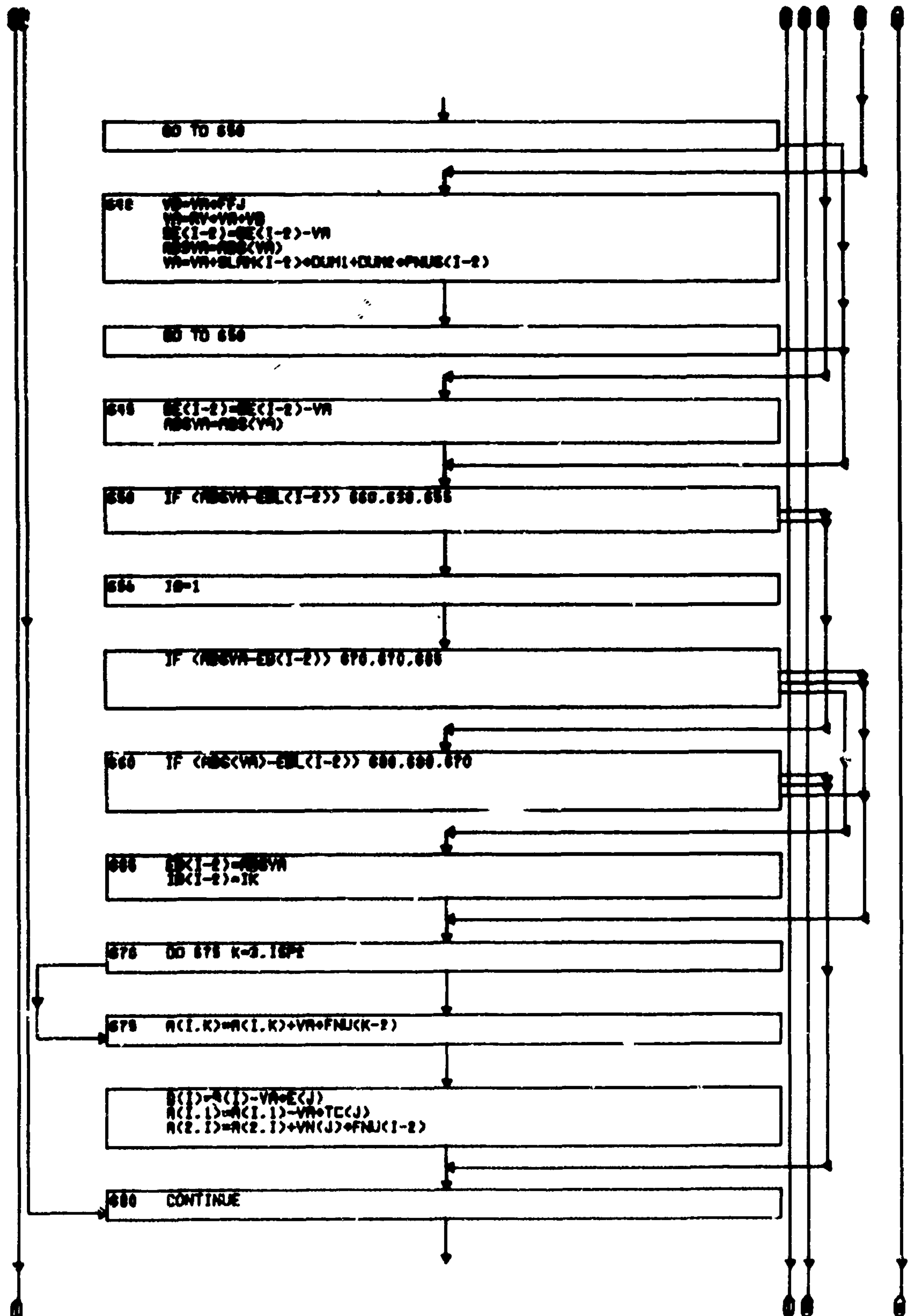


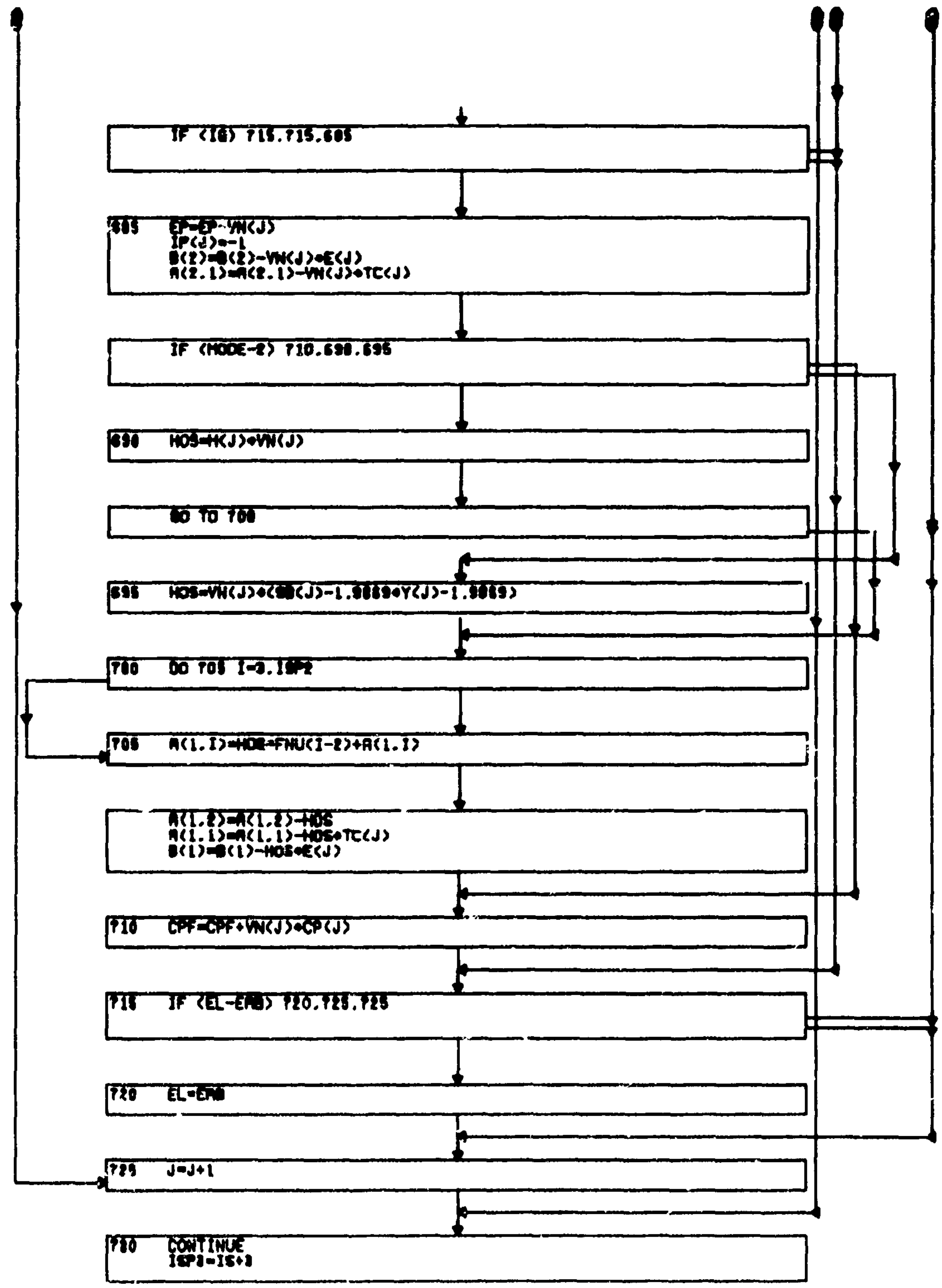
490 A(IE,1)=TC(JC)
B(IE)=E(JC)
GO TO 715
600 JJ(K)=J

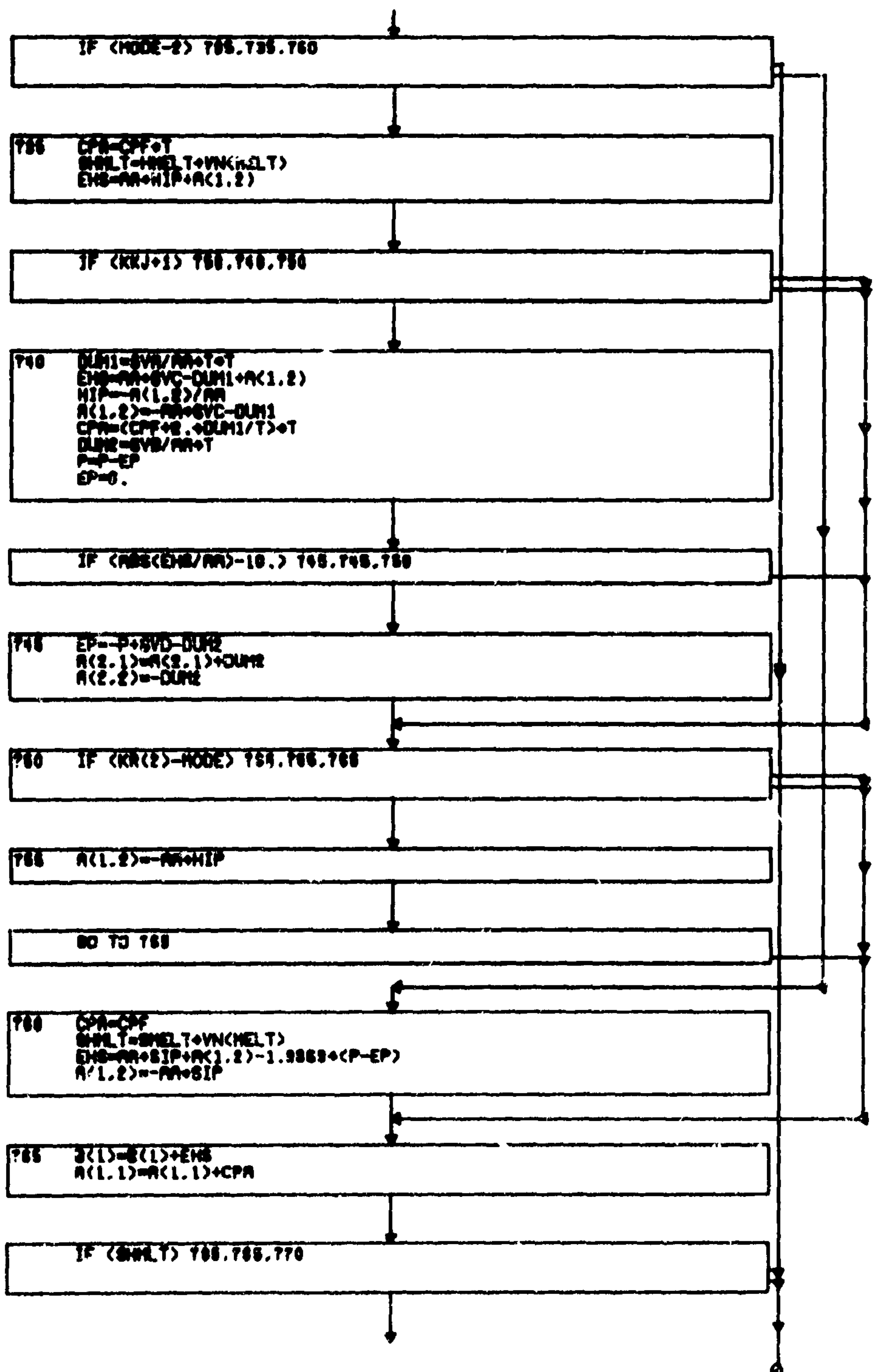

B(IE)=E(J)
IF (T+.001-TF(J)) 515.510.510
510 IF (KR(8)) 530.530.540
515 IF (MODE-1) 520.520.520
525 A(IE,IE)=1.E+10
MODE=0
IF (MODE-1) 715.940.715
540 IF (T-TF(J)-.001) 545.545.560
545 IF (JC) 555.555.550
IF (E(J)-BJC) 725.725.555
BJC=E(J)
JC=IK
IFCJC=IFC(JC)
TMAX=TF(J)
IF (KR(8)) 585.585.580

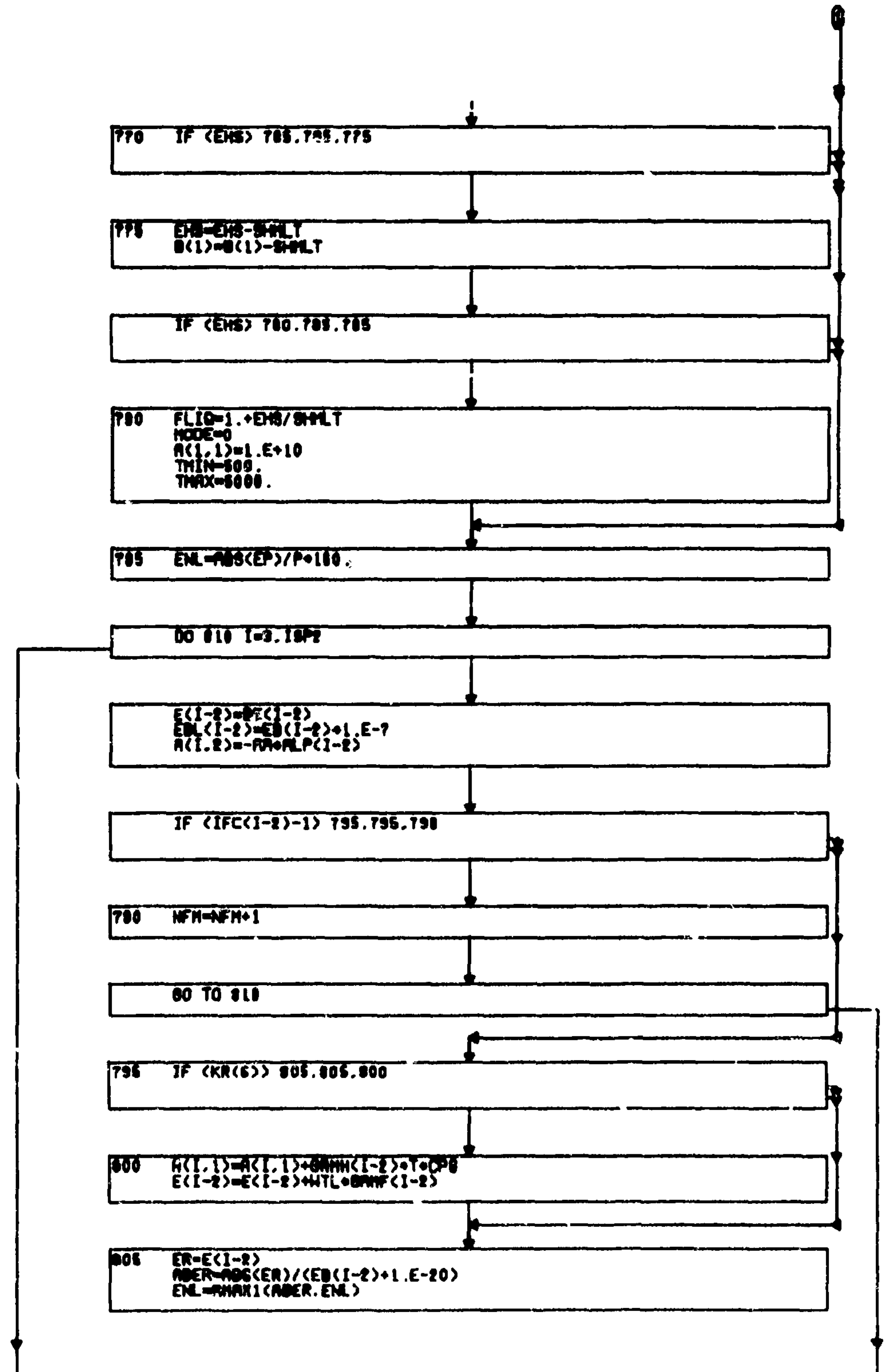

GO TO 715
C GAS PHASE SPECIES
IF (VN(J)) 595,715,595

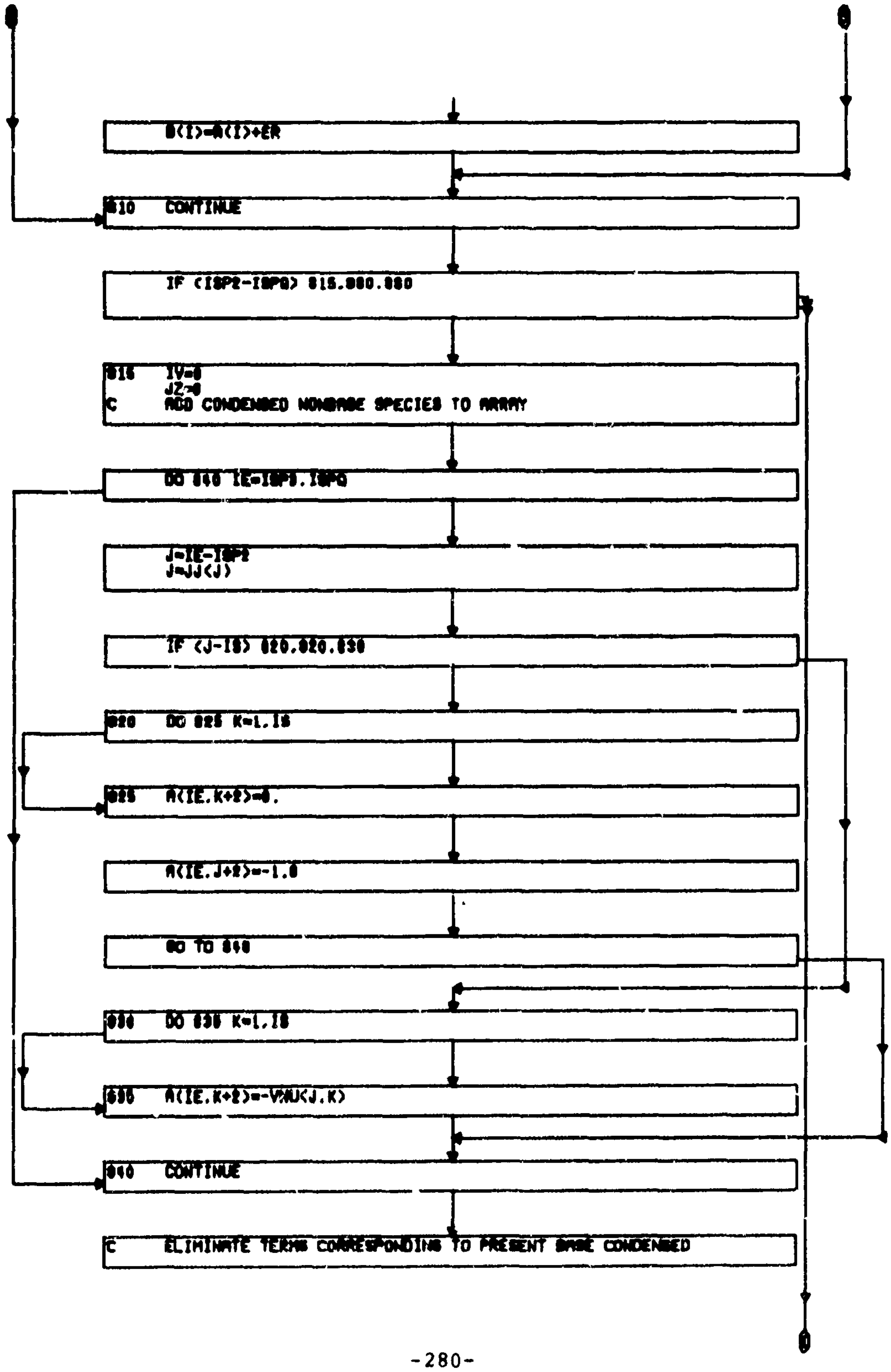

CPB=CPB+VN(J)*CP(J)
IF (KR(6)) 625,600,605
600 FFJ=FFF/FF(J)
605 DUM1=WTN(J)/WTB*VN(J)
DUM2=DUM1/WTB*WTL
IF (KR(6)) 610,610,625
610 IF (KR(4)) 615,615,620
615 DUM1=0.
FFJ=1.0
GO TO 625
620 DUM1=DUM1*(1.-FFJ)
625 DO 690 KI=1,IS
I=2-IR(KI)
VA=VNU(J,I-2)*VN(J)
IF (KAT(KI)-99) 630,645,630
630 IF (KR(5)) 645,640,635
635 VA=VA+RV+VN(J)*(VLAM(J,I-2)+BAMH(I-2)*H(J))
BE(I-2)=BE(I-2)-VA
ABSVA=ABS(VA)
VA=VA+PNUS(I-2)*DUM2

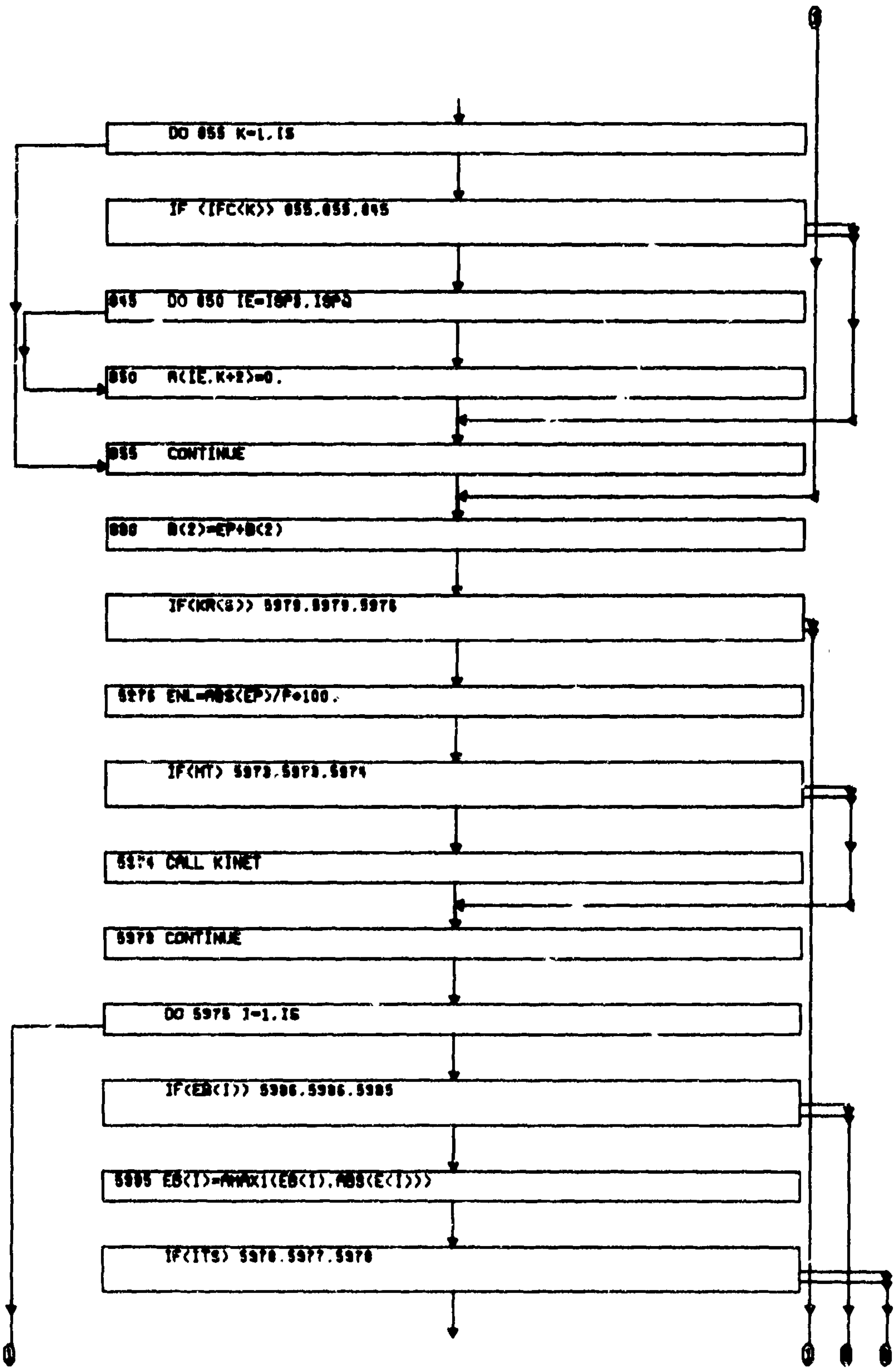

GO TO 650
IF (ABSVA-EBL(I-2)) 660.650.655
IF (ABS(VA)-EBL(I-2)) 680.680.670
IB(I-2)=IK
A(I.K)=A(I.K)+VA*FNU(K-2)
A(I.1)=A(I.1)-VA*TC(J)
A(2.I)=A(2.I)+VN(J)*FNU(I-2)
680 CONTINUE


IF (IG) 715,715,685
685 EP=EP-VN(J)
IP(J)=-1
B(2)=B(2)-VN(J)*E(J)
A(2,1)=A(2,1)-VN(J)*TC(J)
IF (MODE-2) 710,690,695
690 HOS=H(J)*VN(J)
GO TO 700
695 HOS=VN(J)*(SB(J)-1.9869*Y(J)-1.9869)
700 DO 705 I=3,ISP2
705 A(1,I)=HOS*FNU(I-2)+A(1,I)
A(1,2)=A(1,2)-HOS
A(1,1)=A(1,1)-HOS*TC(J)
B(1)=B(1)-HOS*E(J)
710 CPF=CPF+VN(J)*CP(J)
715 IF (EL-EMB) 720,725,725
720 EL=EMB
725 J=J+1
730 CONTINUE
ISP2=IS+2

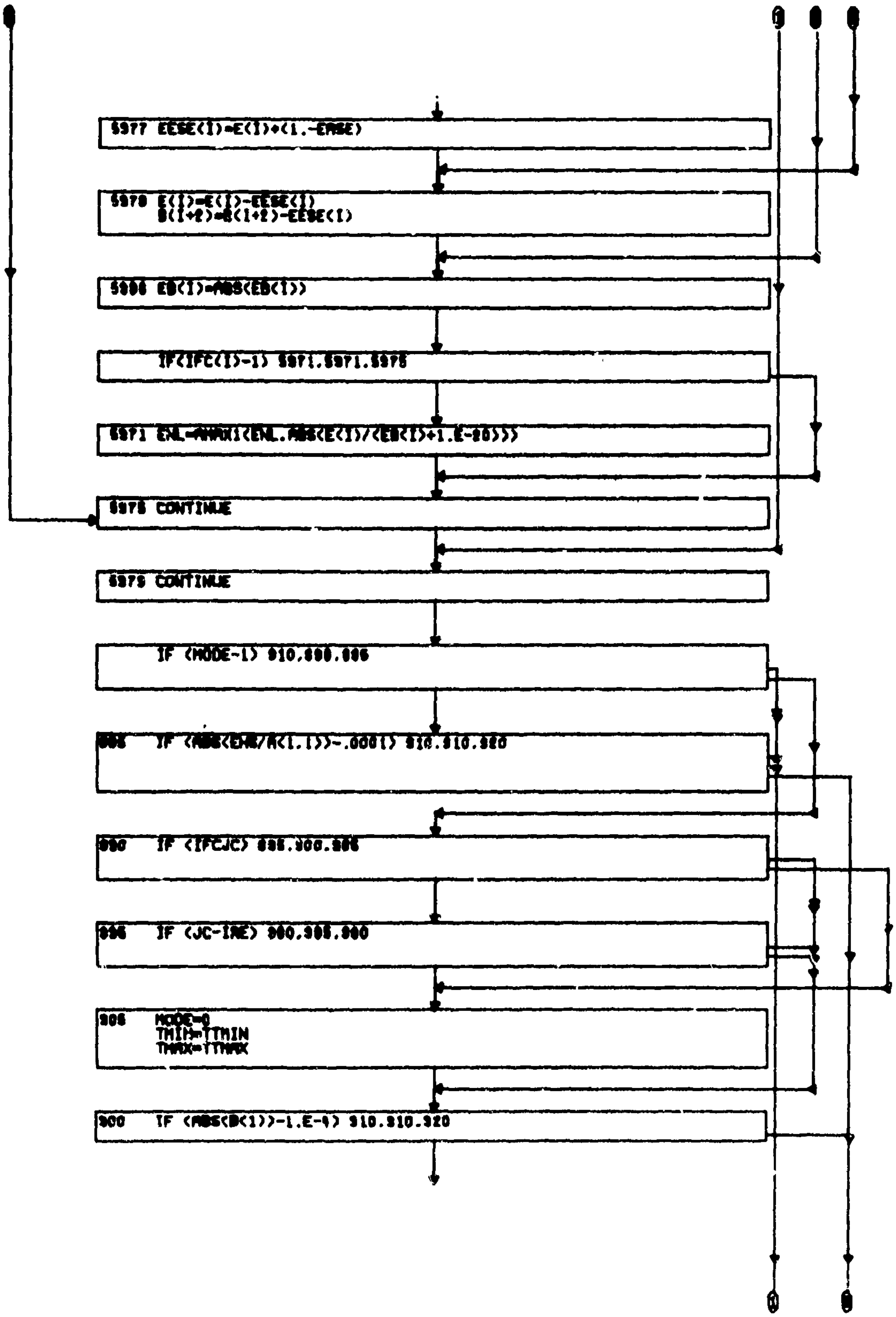

IF (MODE-2) 765,735,760
735 CPA=CPF*T
SHMLT=SHMELT+VN(MELT)
EHS=AA*HIP+A(1,2)
IF (KKJ+1) 750,740,750
740 DUM1=SVB/AA*T*T
EHS=AA*SVC-DUM1+A(1,2)
HIP=-A(1,2)/AA
A(1,2)=-AA*SVC-DUM1
CPA=(CPF+2.*DUM1/T)*T
DUM2=SVB/AA*T
P=P-EP
EP=0.
IF (ABS(EHS/AA)-10.) 745,745,750
745 EP=-P+SVD-DUM2
A(2,1)=A(2,1)+DUM2
A(2,2)=-DUM2
750 IF (KR(2)-MODE) 755,755,760
755 A(1,2)=-AA*HIP
GO TO 765
760 CPA=CPF
SHMLT=SHMELT+VN(MELT)
EHS=AA*SIP+A(1,2)-1.9869*(P-EP)
A(1,2)=-AA*SIP
765 S(1)=S(1)+EHS
A(1,1)=A(1,1)+CPA
IF (SHMLT) 760,765,770

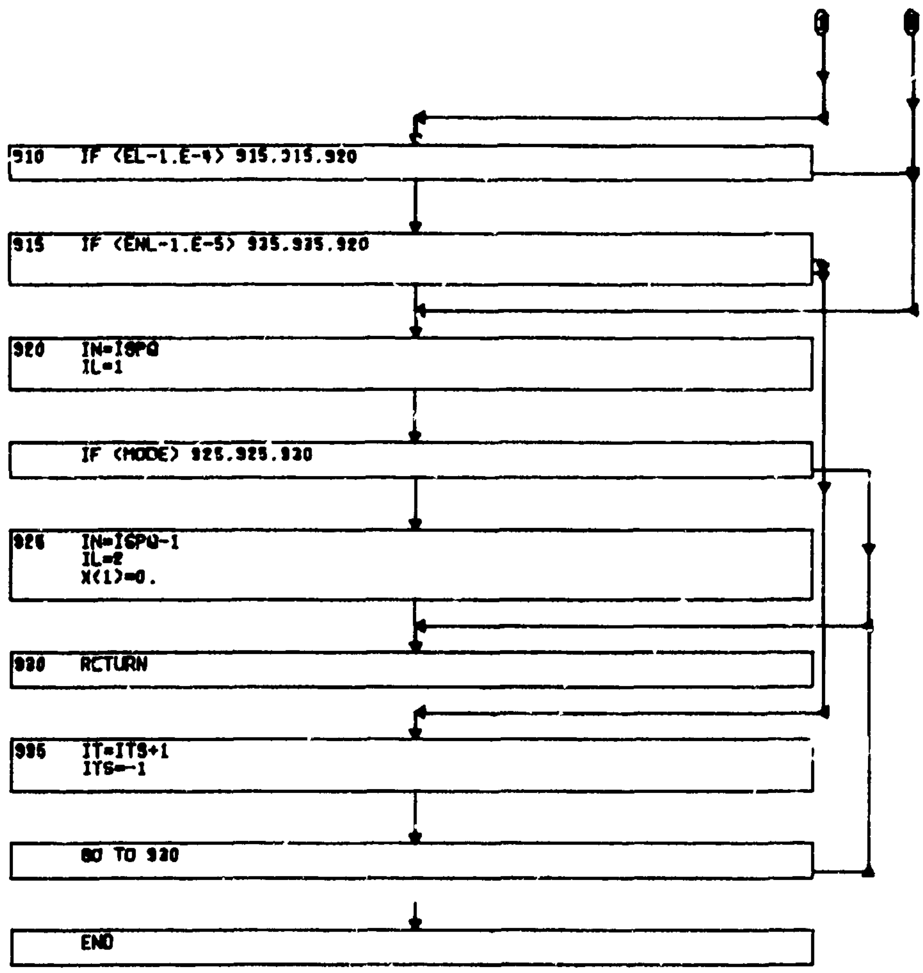

770 IF (EHS) 785,785,775
775 EHS=EHS-SHMLT
B(1)=B(1)-SHMLT
IF (EHS) 780,785,785
780 FLIQ=1.+EHS/SHMLT
MODE=0
A(1,1)=1.E+10
TMIN=500.
TMAX=6000.
785 ENL=ABS(EP)/P*100.
DO 810 I=3,ISP2
E(I-2)=BE(I-2)
EBL(I-2)=EB(I-2)*1.E-7
A(I,2)=-AA*ALP(I-2)
IF (IFC(I-2)-1) 795,795,790
790 NFM=NFM+1
GO TO 810
795 IF (KR(6)) 805,805,800
800 A(I,1)=A(I,1)+GAMH(I-2)*T*CPG
E(I-2)=E(I-2)+WTL*GAMF(I-2)
805 ER=E(I-2)
ABER=ABS(ER)/(EB(I-2)+1.E-20)
ENL=AMAX1(ABER,ENL)


B(I)=A(I)+ER
810 CONTINUE
IF (ISP2-ISPQ) 815.880.880
815 IV=0
JZ=0
C ADD CONDENSED NONBASE SPECIES TO ARRAY
DO 840 IE=ISP3.ISPQ
J=IE-ISP2
J=JJ(J)
IF (J-IS) 820.820.830
820 DO 825 K=1.IS
825 A(IE.K+2)=0.
A(IE.J+2)=-1.0
GO TO 840
830 DO 835 K=1.IS
835 A(IE.K+2)=-VNU(J.K)
840 CONTINUE
C ELIMINATE TERMS CORRESPONDING TO PRESENT BASE CONDENSED



DO 855 K=1.IS
IF (IFC(K)) 855.855.845
845 DO 850 IE=ISP3.ISPQ
850 A(IE.K+2)=0.
855 CONTINUE
860 B(2)=EP+B(2)
IF(KR(8)) 5976.5976.5976
5976 ENL=ABS(EP)/F*100.
IF(MT) 5973.5973.5974
5974 CALL KINET
5973 CONTINUE
DO 5975 I=1.IS
IF(EB(I)) 5986.5986.5985
5985 EB(I)=AMAX1(EB(I).ABS(E(I)))
IF(ITS) 5978.5977.5978


5977 EESE(I)=E(I)*(1.-EMSE)
5978 E(I)=E(I)-EESE(I)
B(I+2)=B(I+2)-EESE(I)
5986 EB(I)=ABS(EB(I))
IF(IFC(I)-1) 5971,5971,5975
5971 ENL=AMAX1(ENL,ABS(E(I)/(EB(I)+1.E-20)))
5975 CONTINUE
5979 CONTINUE
IF (MODE-1) 910,890,895
895 IF (ABS(ENB/A(1,1))-.0001) 910,910,920
890 IF (IFCJC) 895,900,895
896 IF (JC-IRE) 900,905,900
905 MODE=0
TMIN=TTMIN
TMAX=TTMAX
900 IF (ABS(B(1))-1.E-4) 910,910,920


910 IF (EL-1.E-4) 915,915,920
915 IF (ENL-1.E-5) 935,935,920
920 IN=ISPQ
IL=1
IF (MODE) 925,925,930
925 IN=ISPQ-1
IL=2
X(1)=0.
930 RETURN
935 IT=ITS+1
ITS=-1
GO TO 930
END

24. SUBROUTINE CRECT (MOE) - B23A

a. Function

Corrects state variables and composition, principal logic being involved with limiting corrections such that instabilities in the iterations will not occur. Called by EQUIL.

MOE = 0 or 1 if linearlization done predominantly on equilibrium or mass balance relations, respectively.

b. Listing

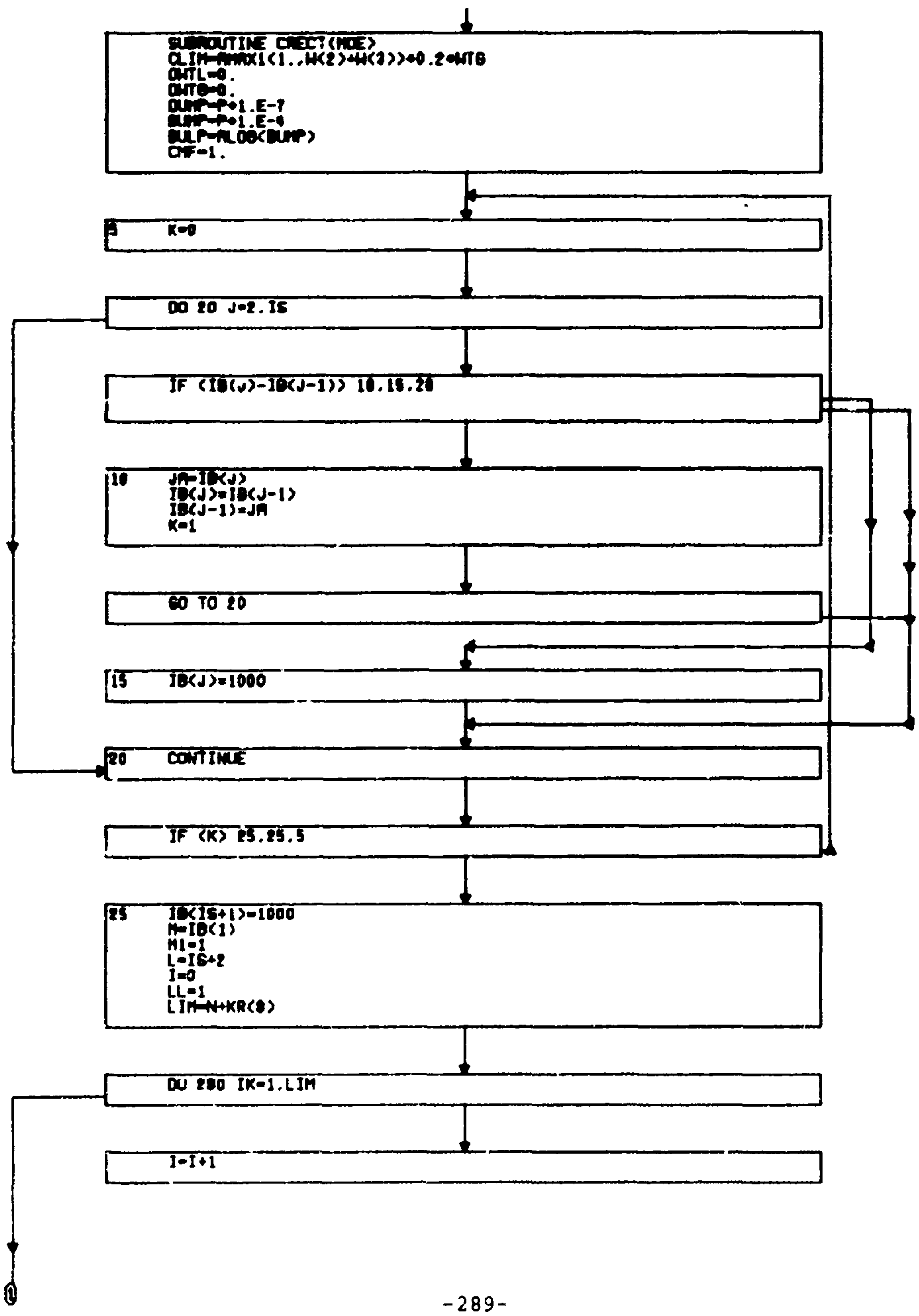
```
      CD23A
            SUBROUTINE CRECT(MODE)
            INTEGER FAMOA,FAMOB
            COMMON/INTCOM/KKR(20),KIN,KOUT
            DIMENSION CIJ( 71,1),TF(1)
            EQUIVALENCE(TU( 72),TF),(VMU,CIJ)
            DIMENSION X(14)
            DIMENSION CMFF( 71)
            COMMON /MLBCOM/FAMOA( 71),FAMOB( 71),N     ,FR( 71,15),W(3),LEF(15)
           1,LEFS(15),PIEASE,LEFA(15)
            COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),
           1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),
           2 KAT(10),IR(10),IS,KR(10),LAM( 71),S,T,TK(10, 7),VM( 71),
           3 VMU( 71,10),ITFF,KR2,MCN,MCV,WM,WTT( 71),Y( 71),YW( 71),SG( 71)
           4 ,T3(10, 7),EPOWRK,SIGMA,BASMOL
            COMMON /EQTCOM/SIP,MIP,EL,EML,SLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,
           1 MODE,WMELT,SMELT,TMAX,TMIN,MELT,SUMM,BUML,VS,VSS,B1,IBP2,IBPB,
           2 ISP,KKJ,SVA,SVB,SVC,SVD,BUMC,FFF,CMF,EP,RV,IFCJC,VTG,VTL,JC,MG,
           3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),
           4 IP( 71),ALP(10),FMU(10),GAMMA, IMM,CJMF(10),SLAM(10),DY( 71),RVB,
           5 CP( 71),H( 71),BB( 71),TC( 71),VLMK( 71),E( 71),PLUS(10),
           6 RC(10),BLMK(10),BY(10),IBC(10),BE(10),JJ( 4)
            EQUIVALENCE(DY1,CY)
            DIMENSION DYA(1,1)
            EQUIVALENCE(B,X)
            CLIM=AMAX1(1.,W(2)+W(3))*5.2*KTG
            DNTL=0.
            DNTS=0.
            DUMPP=1.E-7
            BUMPP=1.E-4
            BULP=ALOG(BUMP)
            CMF=1.
      5     K=0
            DO 20 J=2,IS
            IF (IB(J)-IB(J-1)) 10,15,20
      10    JA=IB(J)
            IB(J)=IB(J-1)
            IB(J-1)=JA
            K=1
            GO TO 20
      15    IB(J)=1000
      20    CONTINUE
            IF (K) 25,25,5
      25    IB(IS+1)=1000
            M=IB(1)
            M1=1
            L=IS+2
            I=0
            LL=1
            LIM=NOKR(8)
            DO 280 IK=1,LIM
            I=I+1
            IF (IK-IS) 30,30,45
      30    SLAM(I)=0.
            IRC(I)=IFC(I)
            PLUS(I)=0.
            IF (IFC(I)-1) 35,35,75
      35    DY1=X(I+2)
```

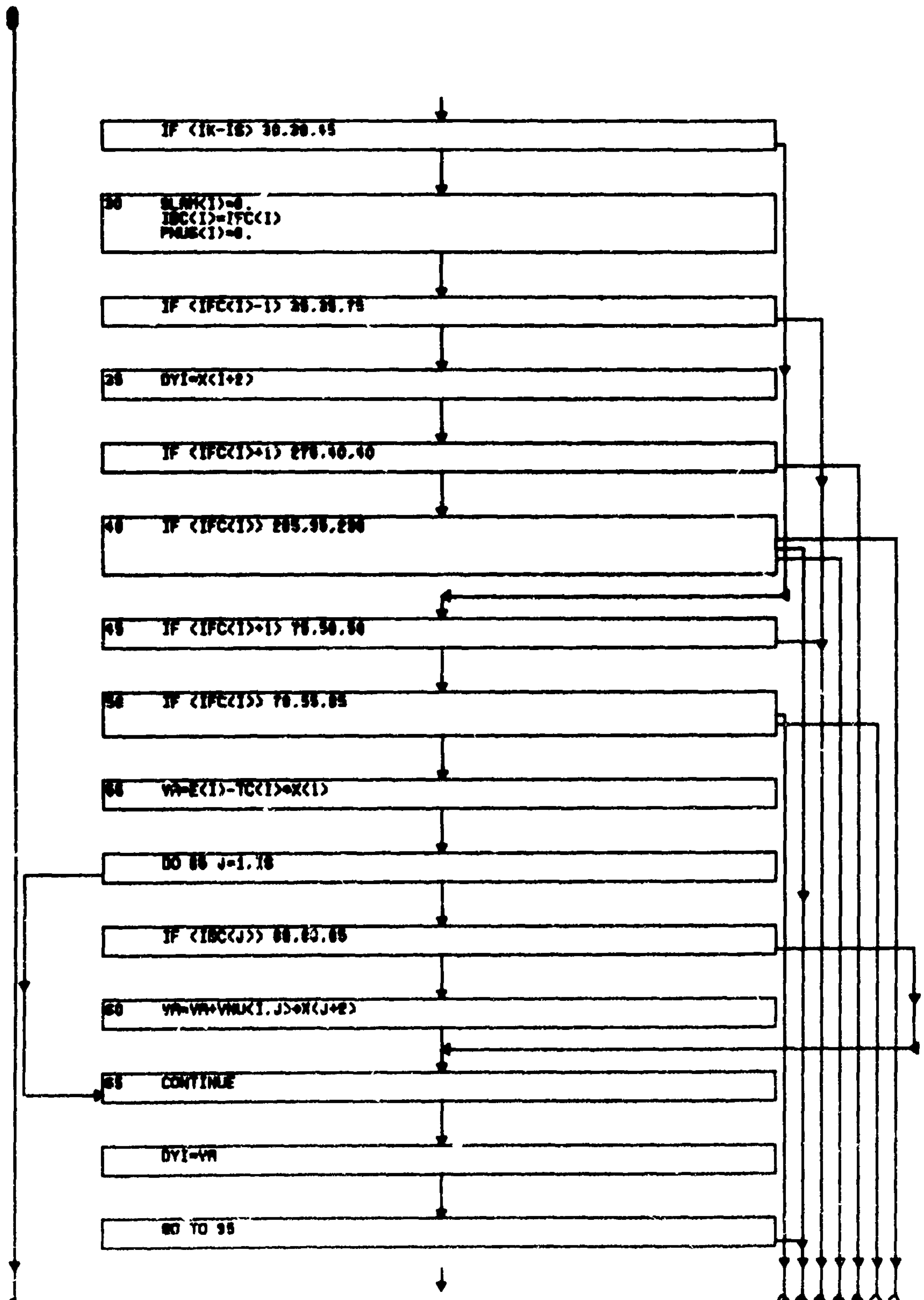
```
      IF (IFC(I)+1) 275,40,40
40    IF (IFC(I)) 205,45,230
45    IF (IFC(I)+1) 75,50,50
50    IF (IFC(I)) 70,55,85
55    VA=E(I)-TC(I)*X(1)
      DO 65 J=1,IS
      IF (IBC(J)) 60,60,65
60    VA=VA+VNJ(I,J)*X(J+2)
65    CONTINUE
      DVI=VA
      GO TO 95
70    IF (IK-IRE) 75,80,75
75    DVI=0.
      GO TO 275
80    IFC(I)=1
      DVI=X(IER)
      GO TO 230
85    L=L+1
      IF (L-IER) 90,85,90
90    DVI=X(L)
      GO TO 230
95    DWTG=DWTG+VN(I)*DVI*WTM(I)
      IF (IP(I)) 100,195,100
100   IF (IK-M) 105,145,105
105   IF (VN(I)-BUMP) 110,140,140
110   IF (MOE) 195,195,115
115   IF (DVI) 120,275,125
120   IF (VN(I)/BUMP-.9999995-CMF*DVI) 275,275,130
125   IF (BUMP/VN(I)-1.-CMF*DVI) 135,275,275
130   CMF=(VN(I)/BUMP-.9999995)/DVI
      GO TO 275
135   CMF=(BUMP/VN(I)-1.)/DVI
      GO TO 275
140   IF (MOE) 175,175,150
145   M1=M1+1
      M=IB(M1)
150   IF (DVI) 155,275,160
155   IF (DVI*CMF+.999) 165,275,275
160   IF (DVI*CMF-9.) 275,275,170
165   CMF=-.999/DVI
      GO TO 275
170   CMF=9./DVI
      GO TO 275
175   IF (DVI*CMF-2.303) 180,190,190
180   IF (DVI*CMF+6.909) 185,275,275
185   CMF=-6.909/DVI
      GO TO 275
190   CMF=2.303/DVI
      GO TO 275
195   IF (Y(I)-BULP+ABS(DVI)*CMF) 275,200,200
200   CMF=-(Y(I)-BULP)/ABS(DVI)
      GO TO 275
C     NON-PRESENT BASE
205   IF (KR(6)) 215,210,210
210   IF (T-TF(I)+.001) 275,215,215
215   IF (Y(I)+CMF*DVI-0.1) 275,220,220
220   DUM1=(.1-Y(I))/DVI
      IF (DUM1-.001) 275,275,225
225   CMF=DUM1
      GO TO 275
```

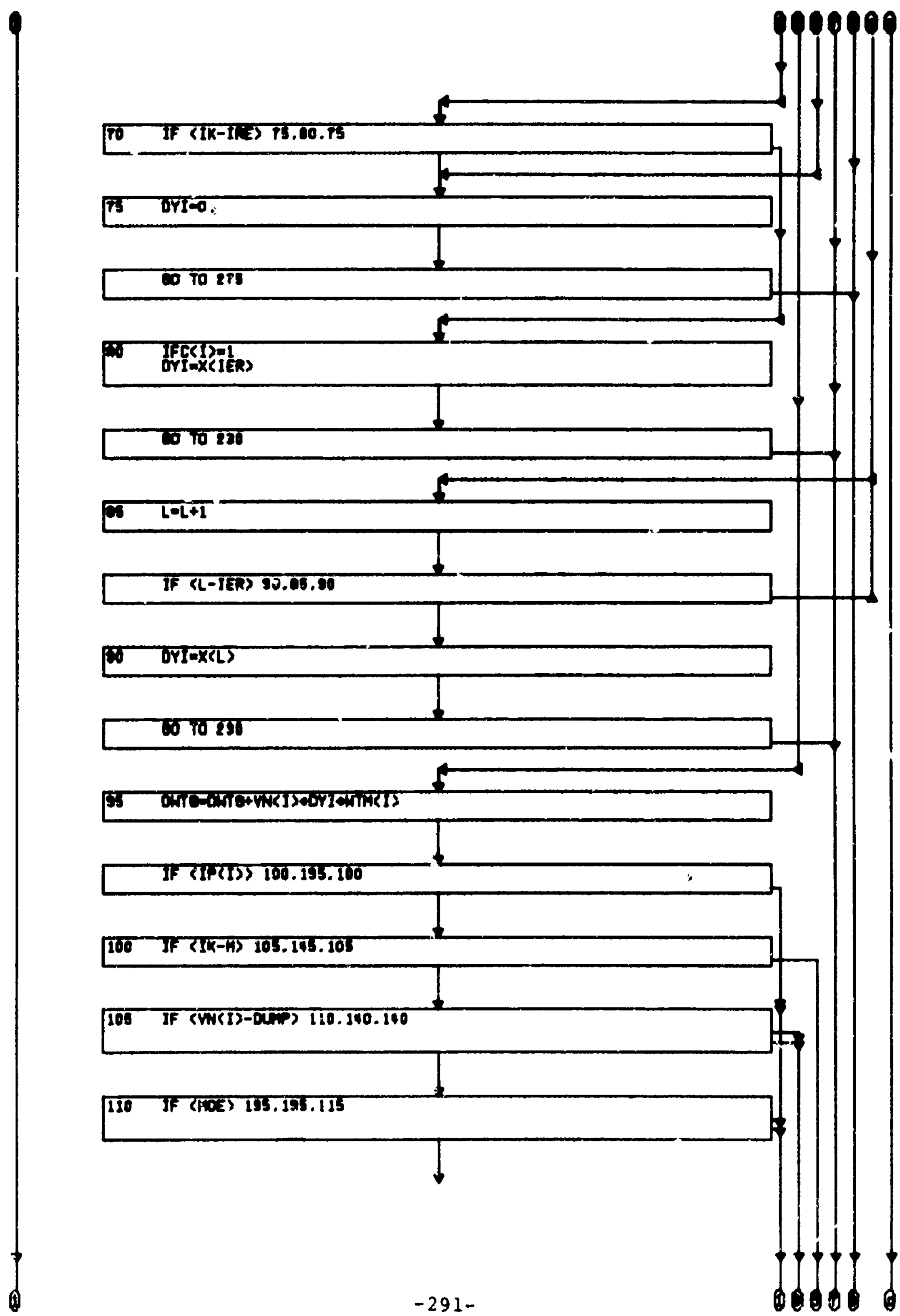
```
230   DWTL=DWTL+DYI*WTP(I)
      IF (DYI) 235,275,250
235   IF (VN(I)) 250,250,240
240   IF (VN(I)+DYI*CMF) 245,250,250
245   CMF=-VN(I)/DYI*1.00001
250   IF (KR(6)) 265,255,255
255   CLIP=ABS(CLIM/WTM(I))
      IF (ABS(CMF*DYI)-CLIP) 275,275,260
260   CMF=CLIP/ABS(DYI)
      GO TO 275
265   IF (ABS(CMF*DYI)-P) 275,275,270
270   CMF=P/ABS(DYI)
275   CMFF(I)=CMF
280   DY(IK)=DYI
      IF (KR(6)) 290,285,285
285   RVL=AMAX1(.1,RV/2.)
      CMF=AMIN1(CMF,WTG/(  (ABS(DWTL-DWTG/WTG*WTL)/RVL-DWTG))
290   IF (KR(7)-1) 315,3   300
295   FORMAT (1X2(8X2HVN  1HY8X2HDY7X5HSCALE7X1HE4X6HIFC IP)/(1XA4,5E10.
     13,I3,I2,1X,A4,5E10.3,I3,I2))
300   NO=I
      WRITE (KOUT,295) (FAMOA(J),VN(J),Y(J),DYA(J,LL),CMFF(J),E(J),IFC(J
     1),IP(J),J=1,NO)
      WRITE (KOUT,310) (EB(I),I=1,IB)
      WRITE (KOUT,310) (X(I),I=1,IBPB)
      WRITE (KOUT,305) (IB(I),I=1,IB)
305   FORMAT (10I5)
310   FORMAT (8E12.4)
315   CONTINUE
      IF (X(1)) 320,360,320
320   X1=X(1)*CMF
      ABX=ABS(X(1))
      IF (ABS(X1)-.5) 330,330,325
325   CMF=.5/ABX
      X1=CMF*X(1)
330   IF (X1) 340,360,335
335   TM=TMAX
      X1=AMIN1(.2,X1)
      GO TO 345
340   TM=TMIN
      X1=AMAX1(-0.2,X1)
345   DTM=(TM-T)/(TM*X1)
      IF (DTM-1.) 350,355,355
350   CMF=DTM*CMF
      T=TM
      GO TO 360
355   T=T/(1.-X1)
360   AA=AA*EXP(CMF*X(2))
      M1=1
      M=IB(1)
      WTL=0.
      WTG=0.
      DUM2=0.
      I=1
      LIM=KR(8)+N
      DO 495 IK=1,LIM
      DYI=CMF*DY(IK)
      IF (DYI) 395,390,395
390   IF (IFC(I)) 495,435,485
395   IF (IFC(I)) 455,400,480
```

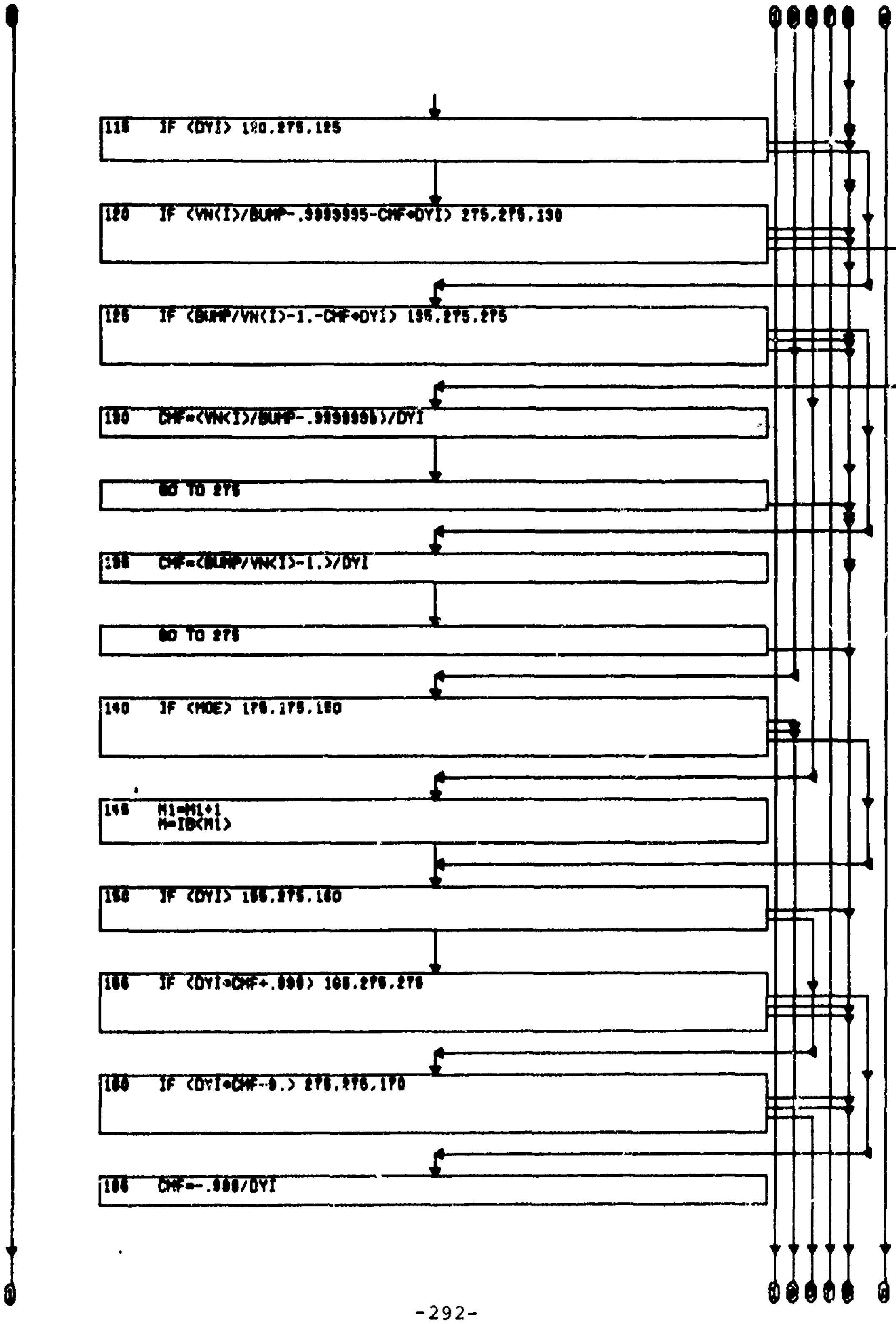
```
400   IF (IP(I)) 405,430,405
405   IF (M-IK) 410,415,410
410   IF (MOE) 430,430,420
415   M1=M1+1
      M=IB(M1)
420   VN(I)=VN(I)*(1.+DYI)
      IF (VN(I)) 430,430,425
425   Y(I)=ALOG(VN(I))
      GO TO 435
430   Y(I)=Y(I)+DYI
      VN(I)=EXP(Y(I))
435   VA=WTM(I)*VN(I)
      WTG=WTG+VA
      DUM2=DUM2+VA/FF(I)
      IF (IK-IS) 440,440,445
440   PNUS(I)=VN(I)
      SLAM(I)=VN(I)/FF(I)
      GO TO 495
445   DO 450 K=1,IS
      VA=VNU(I,K)*VN(I)
      PNUS(K)=PNUS(K)+VA
450   SLAM(K)=SLAM(K)+VA/FF(I)
      GO TO 495
C     NON-PRESENT BASE CORRECTIONS AND TESTS
455   Y(I)=Y(I)+DYI
      IF (Y(I)) 495,460,460
460   IF (IFC(I)+1) 495,465,465
465   IF (KR(6)) 475,470,470
470   IF (T-TF(I)+.001) 495,475,475
475   Y(I)=0.
      IFC(I)=-1
      GO TO 495
480   VN(I)=VN(I)+DYI
      IF (VN(I)) 490,490,485
485   WTL=WTL+VN(I)*WTM(I)
      GO TO 495
490   VN(I)=0.
      IFC(I)=-1
495   I=I+1
      FFF=WTG/DUM2
      DO 500 I=1,IS
500   SLAM(I)=SLAM(I)*FFF
      RETURN
      END
```

c. Flow Chart

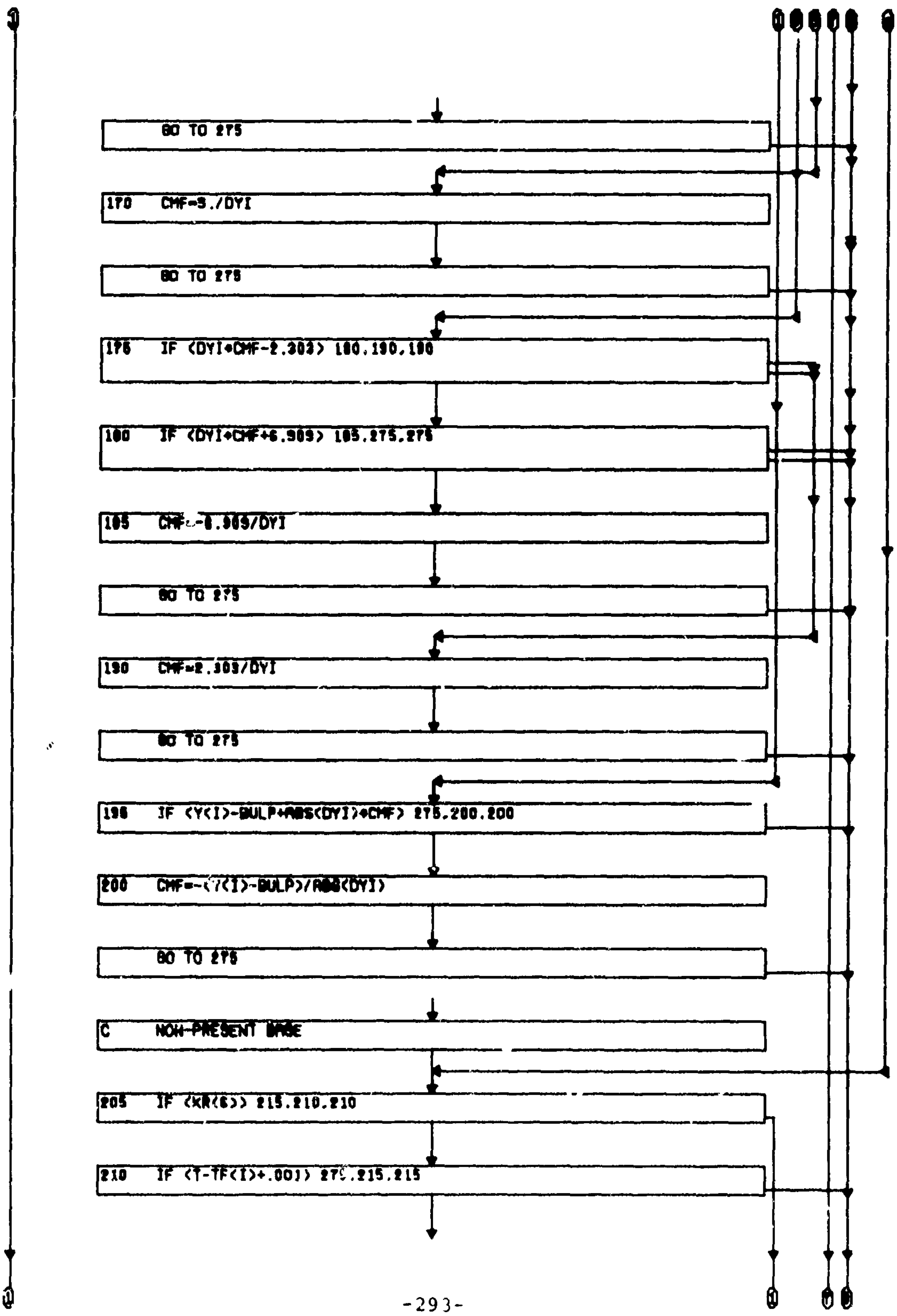

SUBROUTINE CRECT(MOE)
CLIM=AMAX1(1.,W(2)+W(3))+0.2*WTG
DWTL=0.
DWTG=0.
DUMP=P+1.E-7
BUMP=P+1.E-4
BULP=ALOG(BUMP)
CMF=1.
5 K=0
DO 20 J=2,IS
IF (IB(J)-IB(J-1)) 10,15,20
10 JA=IB(J)
IB(J)=IB(J-1)
IB(J-1)=JA
K=1
GO TO 20
15 IB(J)=1000
20 CONTINUE
IF (K) 25,25,5
25 IB(IS+1)=1000
M=IB(1)
M1=1
L=IS+2
I=0
LL=1
LIM=N+KR(8)
DO 280 IK=1,LIM
I=I+1
1

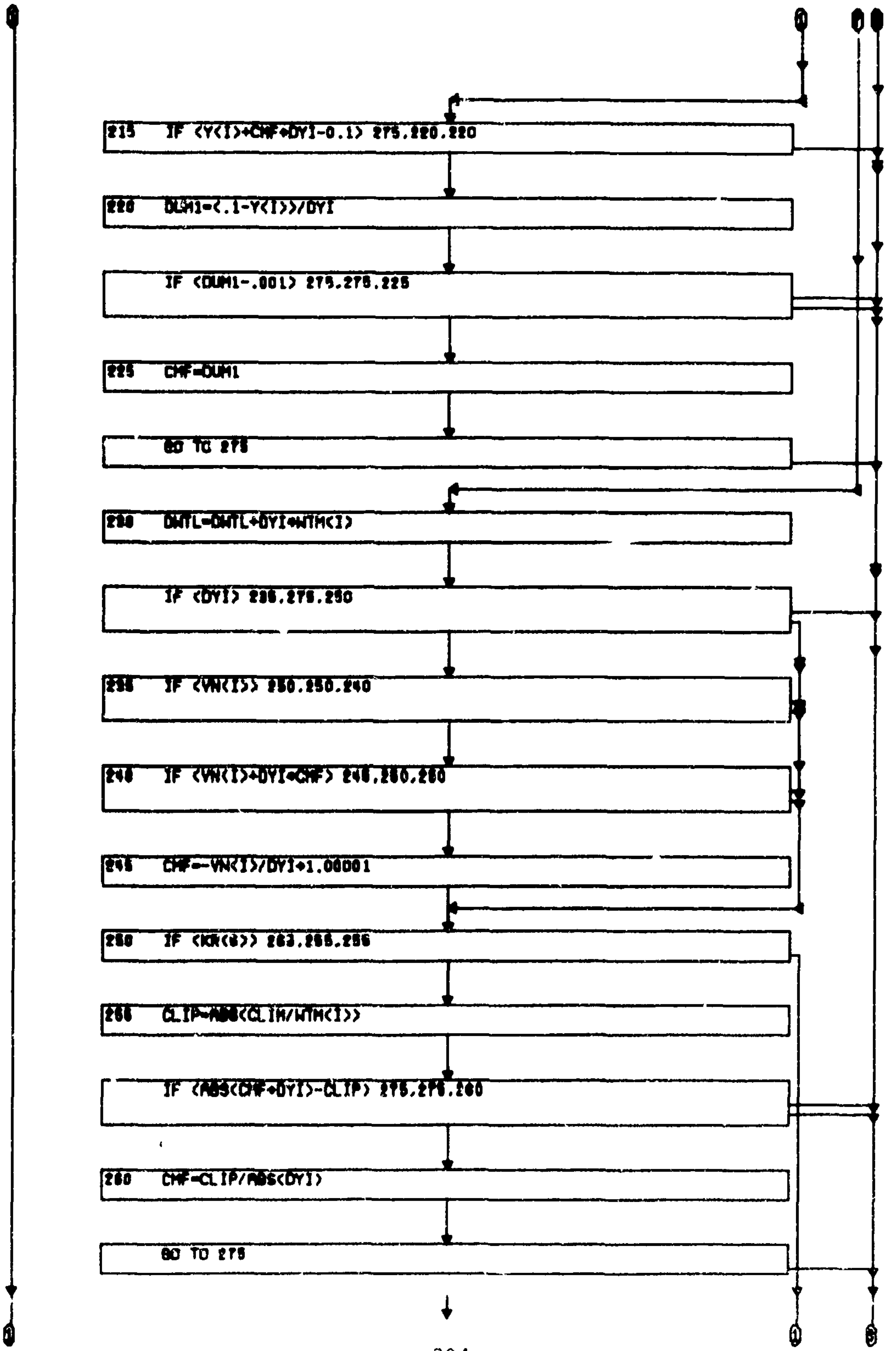

IF (IK-IS) 30,30,45
30 SLAM(I)=0.
IBC(I)=IFC(I)
PMUS(I)=0.
IF (IFC(I)-1) 35,35,75
35 DYI=X(I+2)
IF (IFC(I)+1) 270,40,40
40 IF (IFC(I)) 285,95,290
45 IF (IFC(I)+1) 75,50,50
50 IF (IFC(I)) 70,55,85
55 VA=E(I)-TC(I)*X(I)
DO 65 J=1,IS
IF (IBC(J)) 60,65,65
60 VA=VA+VNU(I,J)*X(J+2)
65 CONTINUE
DYI=VA
GO TO 95


70 IF (IK-IRE) 75,80,75
75 DYI=0.
GO TO 275
80 IFC(I)=1
DYI=X(IER)
GO TO 230
85 L=L+1
IF (L-IER) 90,85,90
90 DYI=X(L)
GO TO 230
95 DWTG=DWTG+VN(I)*DYI*WTM(I)
IF (IP(I)) 100,195,100
100 IF (IK-M) 105,145,105
105 IF (VN(I)-DUMP) 110,140,140
110 IF (MOE) 195,195,115

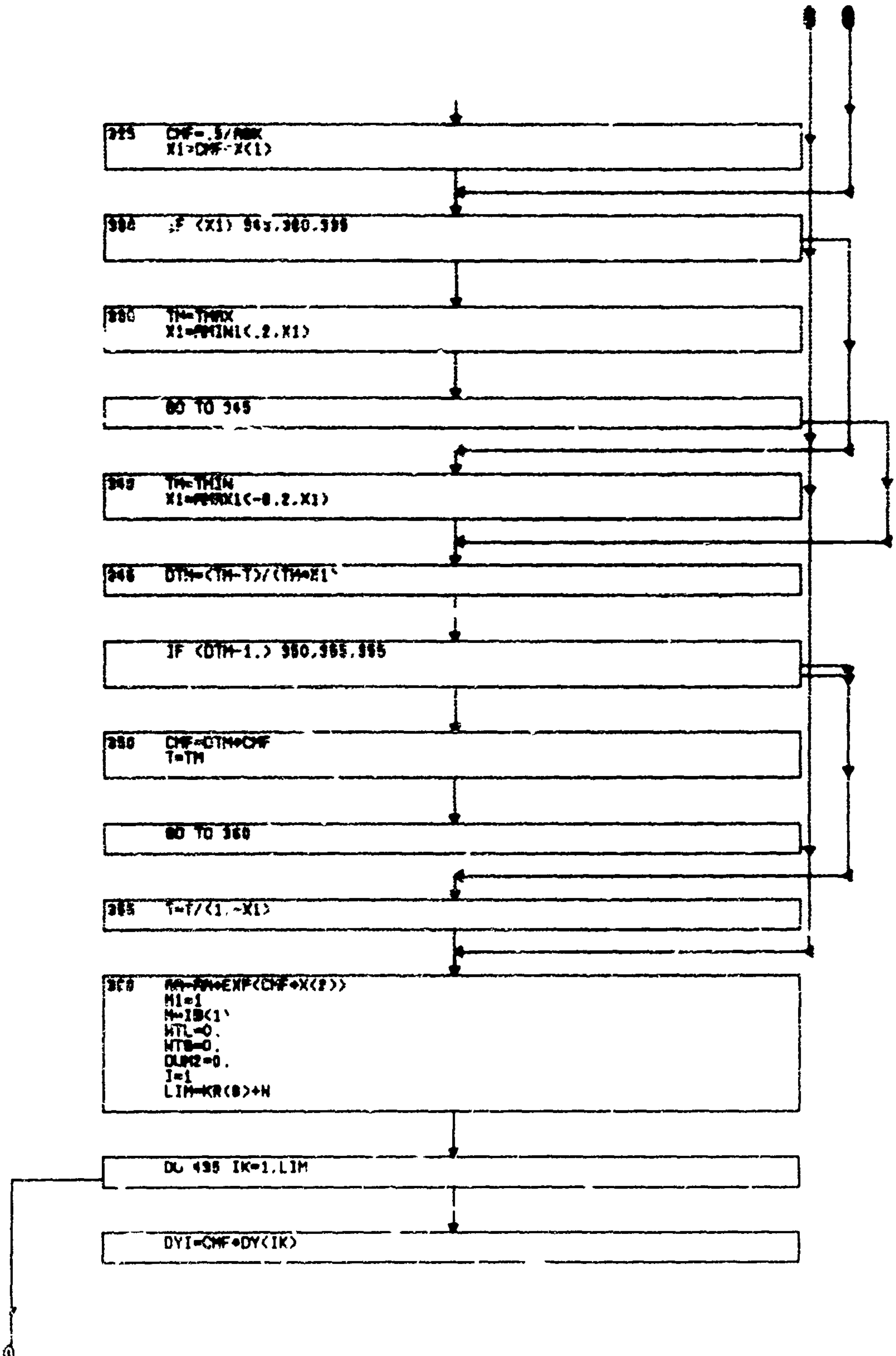


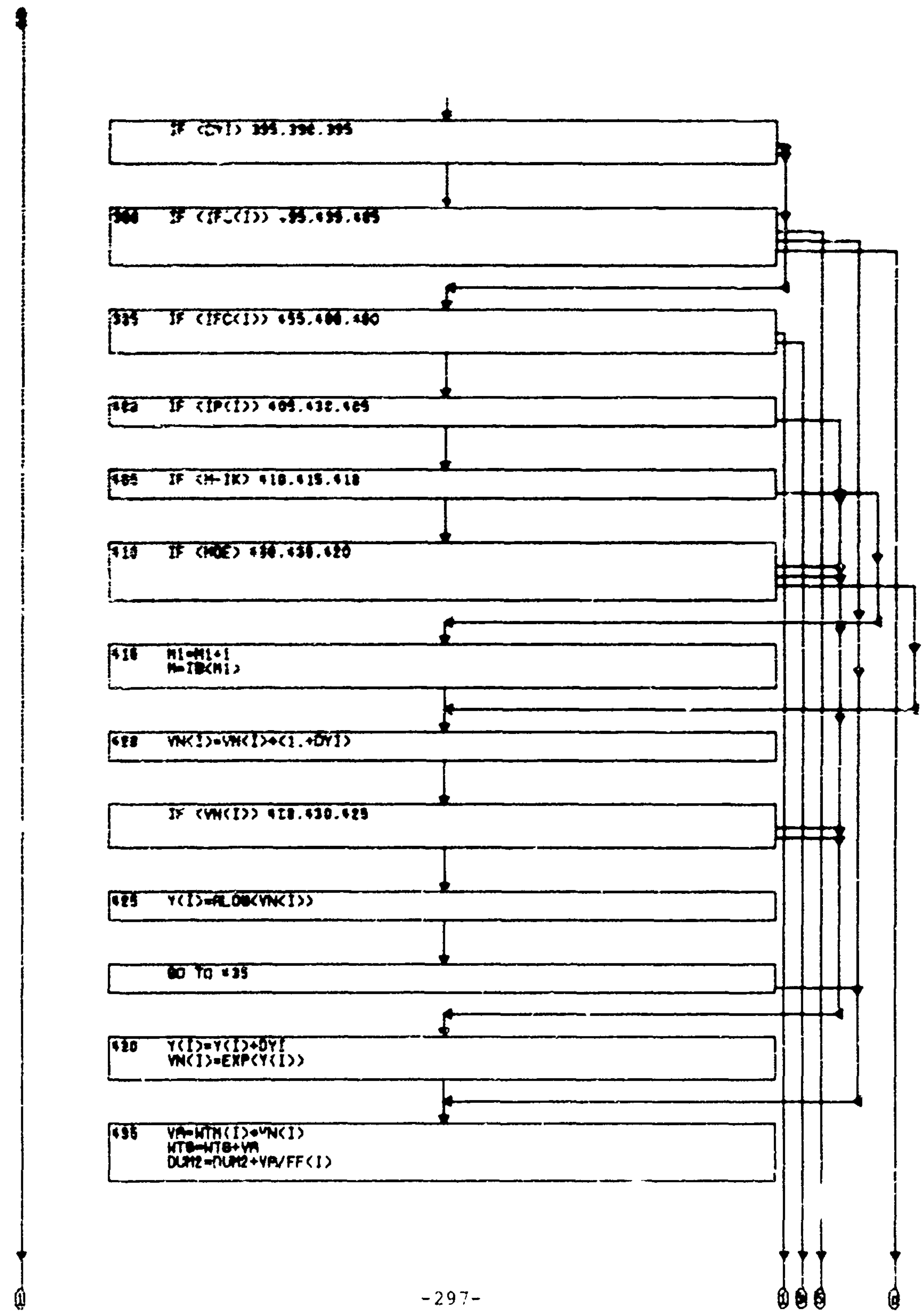
115 IF (DYI) 120,275,125
120 IF (VN(I)/BUMP-.9999995-CMF*DYI) 275,275,130
125 IF (BUMP/VN(I)-1.-CMF*DYI) 135,275,275
130 CMF=(VN(I)/BUMP-.9999995)/DYI
GO TO 275
135 CMF=(BUMP/VN(I)-1.)/DYI
GO TO 275
140 IF (MOE) 175,175,150
145 M1=M1+1
M=IB(M1)
150 IF (DYI) 155,275,160
155 IF (DYI*CMF+.998) 165,275,275
160 IF (DYI*CMF-9.) 275,275,170
165 CMF=-.998/DYI

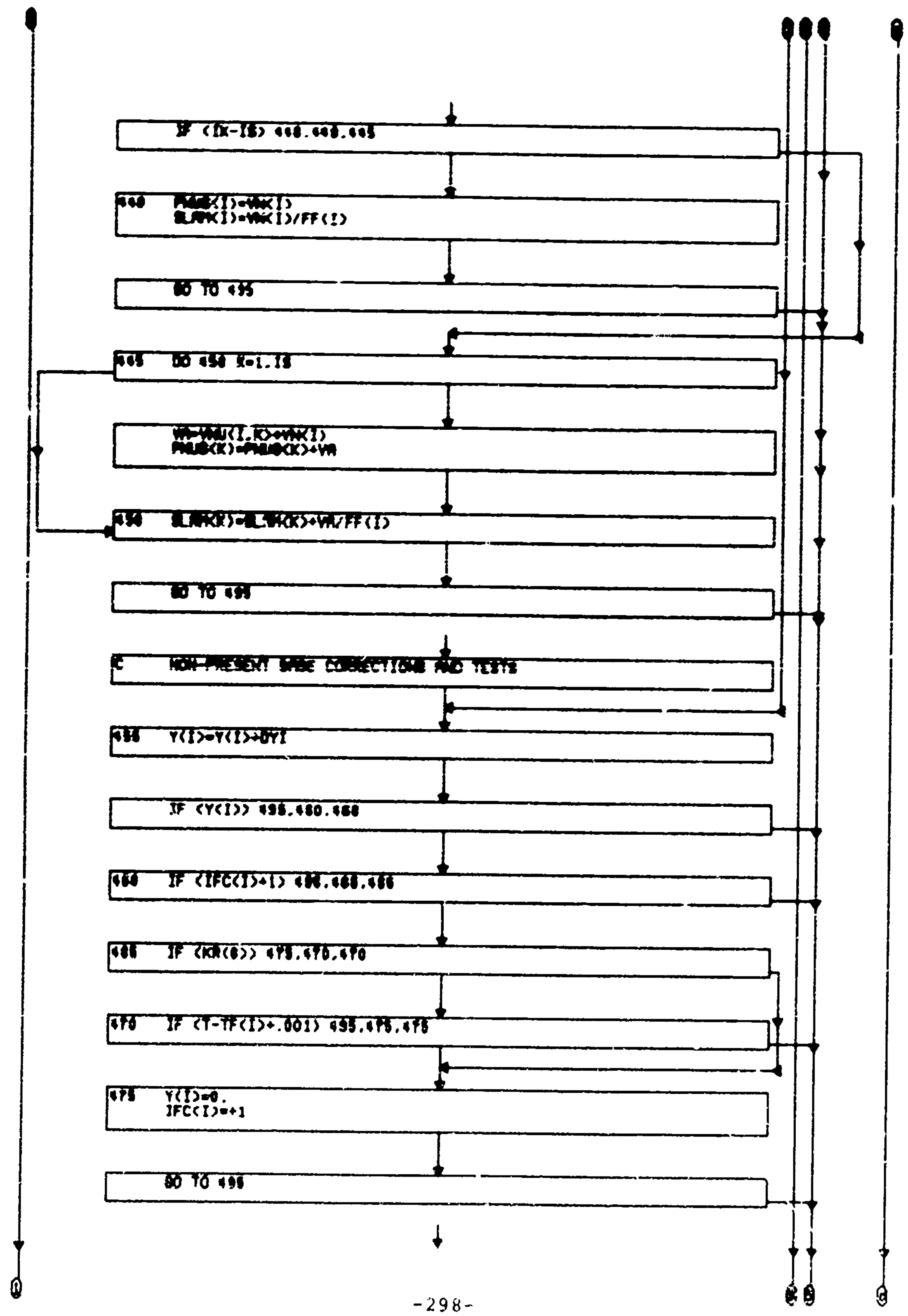

GO TO 275
170 CMF=3./DYI
GO TO 275
175 IF (DYI+CMF-2.303) 180,190,190
180 IF (DYI+CMF+6.909) 185,275,275
185 CMF=-6.909/DYI
GO TO 275
190 CMF=2.303/DYI
GO TO 275
195 IF (Y(I)-BULP+ABS(DYI)*CMF) 275,200,200
200 CMF=-(Y(I)-BULP)/ABS(DYI)
GO TO 275
C NON-PRESENT BASE
205 IF (KR(6)) 215,210,210
210 IF (T-TF(I)+.001) 275,215,215

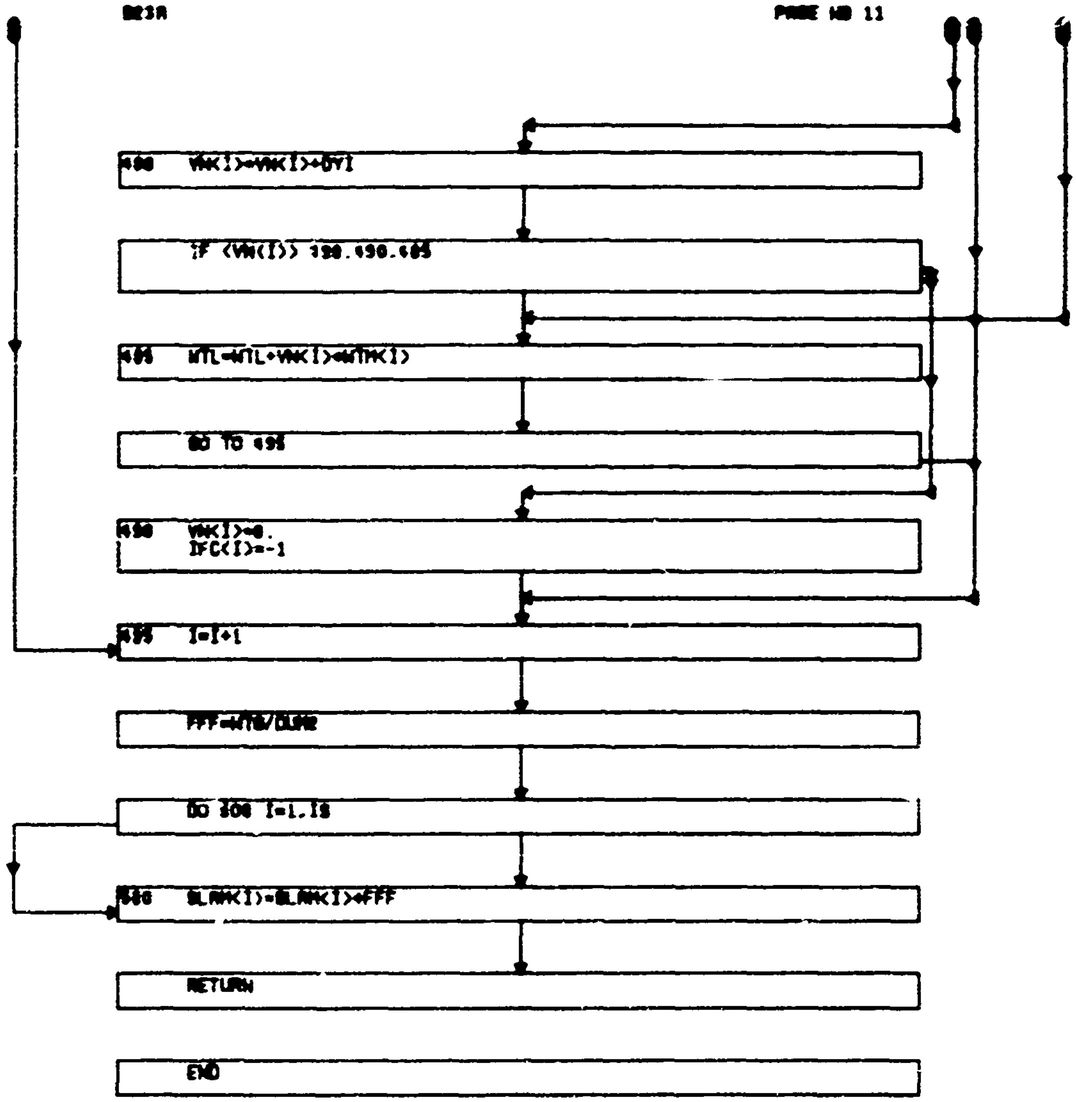

215 IF (Y(I)+CMF*DYI-0.1) 275,220,220
220 DUM1=(.1-Y(I))/DYI
IF (DUM1-.001) 275,275,225
225 CMF=DUM1
GO TO 275
230 DWTL=DWTL+DYI*WTM(I)
IF (DYI) 235,275,250
235 IF (VN(I)) 250,250,240
240 IF (VN(I)+DYI*CMF) 245,250,250
245 CMF=-VN(I)/DYI*1.00001
250 IF (KR(8)) 263,255,255
255 CLIP=ABS(CLIM/WTM(I))
IF (ABS(CMF*DYI)-CLIP) 275,275,260
260 CMF=CLIP/ABS(DYI)
GO TO 275

```
285   IF (ABS(CMF*DYI)-F) 275,275,270
270   CMF=P/ABS(DYI)
275   CMFF(I)=CMF
280   DY(IK)=DYI
      IF (KR(6)) 290,285,285
286   RVL=AMAX1(.1,RV/2.)
      CMF=AMIN1(CMF,WT8/ABS(ABS(DWTL-DWT8/WT8*WTL)/RVL-DWT8))
290   IF (KR(7)-1) 315,315,300
295   FORMAT (1X2(8X2HVN9X1HY8X2HDY7X5HSCALE7X1HE9X6HIFC IP)/(1XA4,5E10.
     13,I3,I2,1X,A4,5E10.3,I3,I2))
300   NQ=I
      WRITE (KOUT,295) (FAMOR(J),VN(J),Y(J),DYR(J,LL),CMFF(J),E(J),IFC(J
     1),IP(J),J=1,NQ)
      WRITE (KOUT,310) (EB(I),I=1,IS)
      WRITE (KOUT,310) (X(I),I=1,ISPQ)
      WRITE (KOUT,305) (IB(I),I=1,IS)
305   FORMAT (10I5)
310   FORMAT (8E12.4)
315   CONTINUE
      IF (X(1)) 320,380,320
320   X1=X(1)*CMF
      ABX=ABS(X(1))
      IF (ABS(X1)-.5) 330,330,325
```


CMF=.5/ABX
X1=CMF*X(1)
IF (X1) 345,380,335
TM=TMAX
X1=AMIN1(.2,X1)
GO TO 345
TM=TMIN
X1=AMAX1(-0.2,X1)
DTM=(TM-T)/(TM*X1)
IF (DTM-1.) 350,355,355
CMF=DTM*CMF
T=TM
GO TO 360
T=T/(1.-X1)
AA=AA+EXP(CMF*X(2))
M1=1
M=IB(1)
WTL=0.
WTB=0.
DUM2=0.
I=1
LIM=KR(8)+N
DO 435 IK=1,LIM
DYI=CMF*DY(IK)


IF (DYI) 395,390,395
390 IF (IFL(I)) 455,435,405
395 IF (IFC(I)) 455,400,400
400 IF (IP(I)) 405,432,405
405 IF (M-IK) 410,415,410
410 IF (MOE) 430,435,420
415 M1=M1+1
M=IB(M1)
418 VN(I)=VN(I)*(1.+DYI)
IF (VN(I)) 418,430,425
425 Y(I)=ALOG(VN(I))
GO TO 435
420 Y(I)=Y(I)+DYI
VN(I)=EXP(Y(I))
435 VA=WTN(I)*VN(I)
WTB=WTB+VA
DUM2=DUM2+VA/FF(I)


IF (IX-IS) 440,440,445
440
SLAM(I)=VNK(I)/FF(I)
GO TO 495
445 DO 450 K=1,IS
450
GO TO 495
C NON-PRESENT SPBE CORRECTIONS AND TESTS
455 Y(I)=Y(I)+DYI
IF (Y(I)) 495,460,460
460 IF (IFC(I)+1) 495,465,465
465 IF (KR(6)) 475,470,470
470 IF (T-TF(I)+.001) 495,475,475
475 Y(I)=0.
IFC(I)=+1
GO TO 495


PAGE NO 11
IF (VN(I)) 3?0,490,485
GO TO 495
I=I+1
DO 500 I=1,IS
RETURN
END

25. SUBROUTINE INPUT - B24A

a. Function

Reads in basic elemental composition data and species property data, selects base species, and sets up stoichiometric coefficients for species formation reactions. Called by REFCON.

b. Listing

```
      CB24A                                                              B24A 001
          SUBROUTINE INPUT(PP)
          INTEGER FAMOA,FAMOB,CHAR,BLANK
          INTEGER AMOA,AMOB,ATA,ATB,ATC                                  B24A 005
          COMMON/INTCOM/KKR(20),KIN,KOUT
          DIMENSION CIJ( 71,1),TF(1)                                     B24A 006*NEW
          DIMENSION UM(10,10)                                            B24A 007*NEW
          EQUIVALENCE(TU( 72),TF),(VNU,CIJ)                              B24A 008*NEW
          DIMENSION C(10),KPHA(2),RA(2), IM(10),JAT(8),ALPT(8),TAU(10,10) B24A 009*NEW
          DIMENSION IC( 10),LIM(10,10)                                   B24A 010*NEW
          DIMENSION FFIN( 71),NFIA( 71),NFIB( 71)                        B24A 011*NEW
          DIMENSION IFMET( 71),ISMET( 71),ZIGEPS(2),SORCE(8)             B24A 012*NEW
          COMMON /BLOCOM/FAMOA( 71),FAMOB( 71),N    ,FR( 71,15),W(3),LEF(10)B24A  13*NEW
         1,LEFS(10),FIEASE,LEFW(10)                                      B24A  14*NEW
          COMMON /EGPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B24A  15*NEW
         1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B24A  16*NEW
         2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),     B24A  17*NEW
         3 VNU( 71,10),ITFF,KR2,NCH,NCV,WM,WTM( 71),Y( 71),YW( 71),GG( 71)  B24A  18*NEW
         4 ,TG(10, 7),EPOVRK,SIGMA,BASMOL                                B24A  19*NEW
          COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIS,CPF,IRE,IER,AA,ITS,IN,IL,IT,   B24A  20*NEW
         1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,S1,ISP2,ISPS,   B24A  21*NEW
         2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HG,  B24A  22*NEW
         3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),   B24A  23*NEW
         4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B24A  24*NEW
         5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),     B24A  25*NEW
         6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)                  B24A  26*NEW
          COMMON/KINCOM/MT,FKF(10),EAK(10),EXK(10),PMU(10,10),RMU(10,10),   B24A  27*NEW
         1 DKPT(10),PKP(10),PKR(10),RAT(10),RSIG(10),MA(10),LL(10),PMR(10), B24A  28*NEW
         2 PRMU(10,10),EESE(10)                                          B24A  29*NEW
  301     FORMAT (I3,F7.0,7F10.4)                                             *-24
   302 FORMAT(6E9.6,2F6.0,I1)
  3020 FORMAT(1X6E12.5,F10.4,F11.4,I2/1X6E12.5,F10.4,F11.4,I2)
  3021 FORMAT(2A4,E12.4,2A4,E12.4,2A4,E12.4,2A4,E12.4)                   B24A 029
   303 FORMAT(1H /1H )                                                   B24A 030
   304 FORMAT(I3,3A4,E9.3,7E8.3)
   305 FORMAT(94HORELATIVE ELEMENTAL COMPOSITIONS, ATOMIC WTS/UNIT MASS  B24A 032
      1/6X6HAT,NO,3X7HELEMENT4X9HATOMIC WT5X8HEDGE GAS4X10HPYRO.GAS 15X
      2 6HCHAR 15X10HPYRO.GAS 25X6HCHAR 25X10HPYRO.GAS 35X6HCHAR 3/
      3 (7XI3,3X3A4,F10.5,7F13.7))
   306 FORMAT(7(F3.0,I3), A2,9A4)
       DATA CHAR,BLANK/4HCHAR,4H    /
       P=PP
       KR(3)=2
       KR(2)=KKR(12)+1
       IF(KR(2).EQ.3.OR.KR(2).EQ.8) KR(3)=6
       IF(KR(2).EQ.7) GO TO 3751
  3062 MT=0
       FFA=0.489
       FITMOL=26.7
       FITGMW=24.3
       GGA = 0.454
       BASMOL=32.0
       SIGMA=3.467
       EPOVRK=106.7
       NFF=0                                                             B24A 042
       VINT=P*1.E-6                                                      B24A 043
       YINT=ALOG(VINT)                                                   B24A 044
       RMMG=1.                                                           B24A 045
```

```
      IF (KR(2)) 334,334,321                                            B24A 046
  321 READ(KIN,301) IS,FFAR,DUB2,DUB3,DUB4,DUB5,DUB6,DUB7,DUB8
      IF (DUB2.GT.0.) FITMOL=DUB2
      IF (DUB3.GT.0.) BASMOL=DUB3
      IF (DUB4.GT.0.) SIGMA=DUB4
      IF (DUB5.GT.0.) EPOVRK=DUB5
      IF (DUB6.GT.0.) GGA =DUB6
      IF (DUB7.GT.0.) FITGMW=DUB7
      IF(FFAR) 3213,3212,3211                                           B24A 048
 3213 FFA=0.                                                            B24A 049
      GO TO 3212                                                        B24A 050
 3211 FFA=FFAR                                                          B24A 051
 3212 CONTINUE                                                          B24A 052
      JAT(8)=0                                                          B24A 053
      IY=3                                                              B24A 054
      IF (IS-10) 311,311,399                                            B24A 055
  311 READ(KIN,304) (KAT(J), ATA(J), ATB(J), ATC(J), WAT(J), (TK(J,I),
     1  I=1,7),J=1,IS)
      DO 327 K=1,7
      VA=0.                                                             B24A 059
      DO 322 J=1,IS                                                     B24A 060
      IF(KAT(J)-99) 3111,325,3111                                       B24A 061
 3111 IF(TK(J,K)) 324,322,325                                           B24A 062
  324 VA=VA-TK(J,K)                                                     B24A 063
      TK(J,K)=-TK(J,K)/WAT(J)                                           B24A 064
      GO TO 322                                                         B24A 065
  325 VA=VA+TK(J,K)*WAT(J)                                              B24A 066
  322 CONTINUE                                                          B24A 067
      IF(VA) 326,327,326
  326 DO 323 J=1,IS
  323 TK(J,K)=TK(J,K)/VA                                                B24A 069
  327 CONTINUE
      WRITE(KOUT,305) (KAT(J), ATA(J), ATB(J), ATC(J), WAT(J), (TK(J,I),
     1  I=1,7),J=1,IS)
      WRITE (KOUT,308)
  308 FORMAT(//3X61HTHERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FO
     1R FORMAT)//)
      ISP=IS+1                                                          B24A 072
      IF(KR(3)) 399,399,334                                             B24A 073
  334 TFMAX=0.                                                          B24A 074
      AAA=0.                                                            B24A 075
      N=0                                                               B24A 076
      II=ISP                                                            B24A 077
      J=1                                                               B24A 078
  342 READ(KIN,306)(ALPT(K),JAT(K),K=1,7),SORCE,AMOA,AMOB
      IF(ALPT(1)) 3421,399,3420
 3420 IF(JAT(1)) 344,3421,344
 3421 NFF=ABS(ALPT(1))
      READ(KIN,3021)(NFIA(I),NFIB(I),FFIN(I),I=1,NFF)                   B24A 082
      GO TO 342                                                         B24A 083
  344 DO 345 K=1,IS
  345 C(K)=0.
      DO 349 I=1,7
      IF(JAT(I)) 346,349,346
  346 DO 347 K=1,IS
      IF(JAT(I)-KAT(K)) 347,348,347
  347 CONTINUE
      READ(KIN,303)
      GO TO 342
  348 C(K)=ALPT(I)
```

```
  349 CONTINUE
      WT=0.
      L=1
      LAMKK=0
      DO 388 I=1,IS
      IF(C(I)) 387,388,387
  387 LAMKK=LAMKK+L
      WT=WT+C(I) * WAT(I)
  388 L=L+L
      IF(J-IS) 360,360,369
  360 JM=J-1
      DO 3601 L=1,IS
 3601 CIJ(L,J)=C(L)
      LAMI(J) = LAMKK
      IF (JM) 320,320,313
  313 DO 314 L=1,JM
      IML=IM(L)
      UGH=C(IML)
      UM(L,J)=0.
      IF(UGH) 353,314,353
  353 DO 393 I=1,L
  393 UM(I,J)=UM(I,J)-UM(I,L)*UGH
      DO 394 I=IML,IS
  394 C(I)=C(I)-TAU(I,L)*UGH
  314 UM(J,L)=0.
  320 DO 316 I=1,IS
      IF(ABS (C(I))-.001)316,316,317
  316 TAU(I,J)=0.
      DO 396 I=1,JM
  396 VNU(II,I)=-UM(I,J)
      DO 397 I=J,IS
  397 VNU(II,I)=0.
      LAMI(II)=LAMKK
      GO TO 370
  317 IM(J)=I
      UM(J,J)=1.
      DO 398 L=1,J
  398 UM(L,J)=UM(L,J)/C(I)
      DO 328 L=I,IS
  328 TAU(L,J)=C(L)/C(I)
      YC=YINT
      KK=J
      J=J+1
      IF(J-IS) 372,372,329
  329 DO 330 L=2,IS
      JM=ISP-L
      IMJ=IM(JM+1)
      DO 330 K=1,JM
      UGH=TAU(IMJ,K)
      DO 330 I=1,IS
  330 UM(I,K)=UM(I,K)-UGH*UM(I,JM+1)
      DO 333 I=1,IS
  337 IMI=IM(I)
      IF(IMI-I) 336,333,336
  336 DO 338 K=1,IS
      V=UM(K,IMI)
      UM(K,IMI)=UM(K,I)
  338 UM(K,I)=V
      IM(I)=IM(IMI)
      IM(IMI)=IMI
```

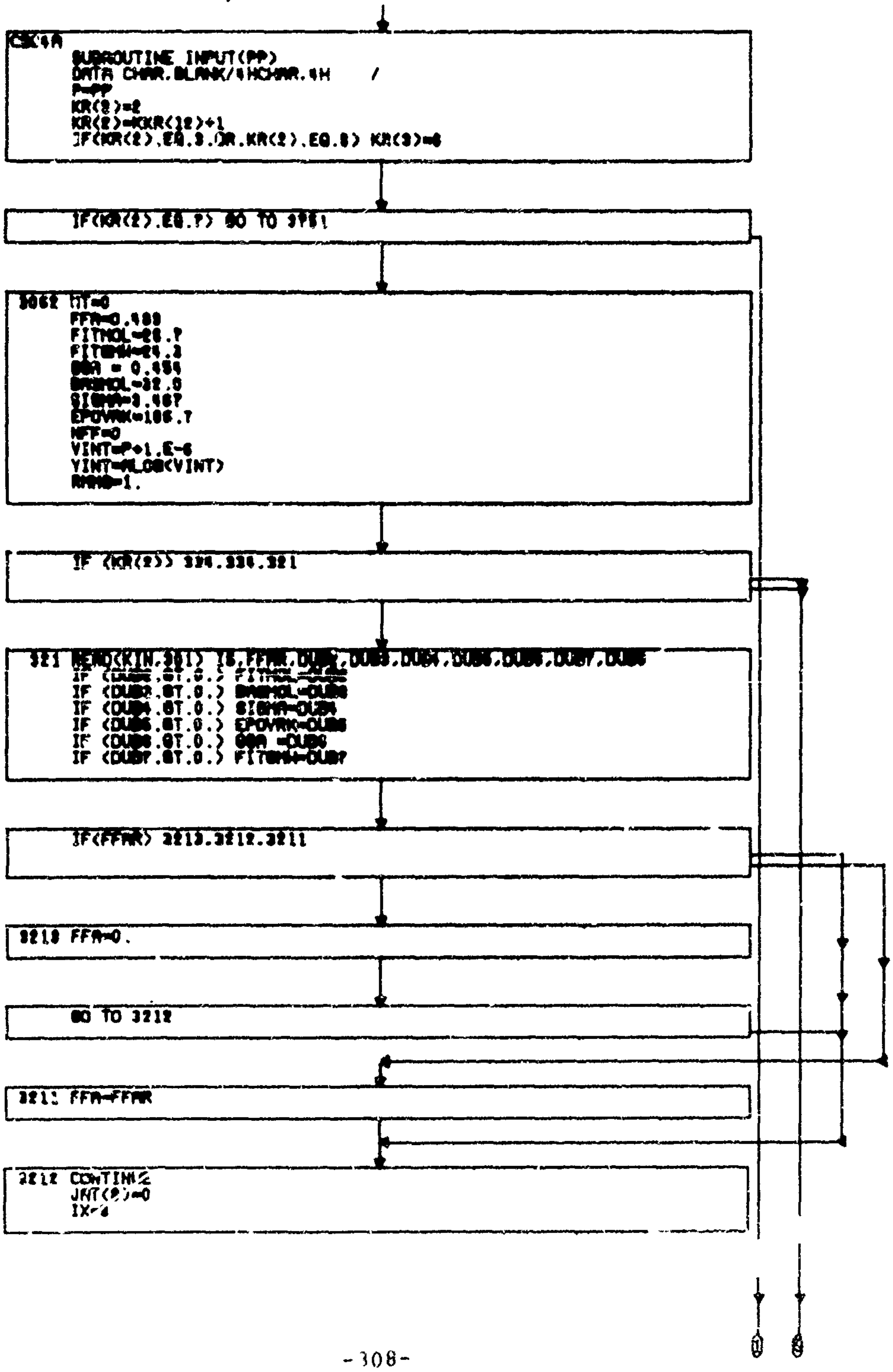
```
      GO TO 337
  333 CONTINUE
C-----ELEMENT -- BASE GAS CORRESPONDENCE
C     INITIALIZE ROW AND COLUMN SUMS
      IG=IS
      DO 401 I=1,IS
      IR(I)=-1
  401 IC(I)=-1
C     EVALUATE INITIAL SUMS
      LAMD=1
      DO 402 I=1,IS
      DO 403 J=1,IS
      LIM(I,J)=MOD(LAMI(J)/LAMD,2)
      IC(J) = IC(J) + LIM(I,J)
  403 IR(I)= IR(I) + LIM(I,J)
  402 LAMD=LAMD+LAMD
C     CHECK FOR ZEROS
  426 IZ=0
  404 DO 412 I=1,IS
      IF(IC(I)-IZ) 408,405,408
  405 DO 406 J=1,IS
      IF(LIM(J,I)) 407,406,407
  406 CONTINUE
  407 IC(I)=-J
      IR(J)=-I
      DO 428 K=1,IS
      LIM(J,I)=0
      IF(LIM(J,K)) 425,427,425
  425 IC(K)=IC(K)-1
      LIM(J,K)=0
  427 IF(LIM(K,I)) 422,428,422
  422 LIM(K,I)=0
      IR(K)=IR(K)-1
  428 CONTINUE
      GO TO 413
  408 IF(IR(I)-IZ)  412,409,412
  409 DO 410 J=1,IS
      IF(LIM(I,J)) 411,410,411
  411 IC(J)=-I
      IR(I)=-J
      LIM(I,J)=0
      GO TO 4101
  410 CONTINUE
 4101 DO 430 K=1,IS
      IF(LIM(K,J))424,429,424
  424 IR(K)=IR(K)-1
      LIM(K,J)=0
  429 IF(LIM(I,K)) 423,430,423
  423 LIM(I,K)=0
      IC(K)=IC(K)-1
  430 CONTINUE
      GO TO 413
  412 CONTINUE
      IZ=IZ+1
      GO TO 404
  413 IG=IG-1
      J=IS+1
      IF(IG) 414,414,426
  414 IF(KR(3)-3) 372,372,415
  415 FAMDA(IS)=AMDA
```

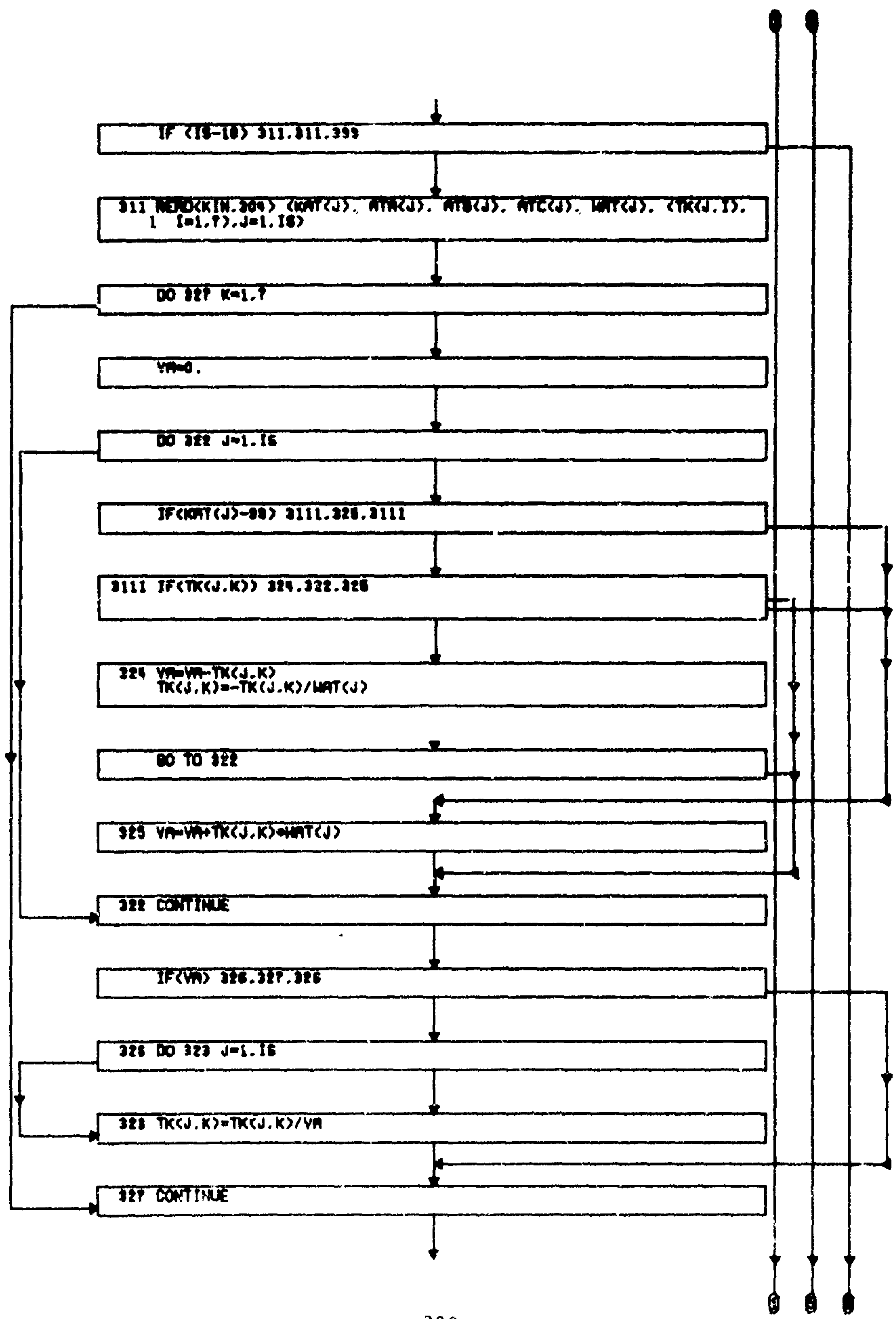
```
      FAMOB(IS)=AMOP                                                    B24A 211
      DO 416 I=1,IS                                                     B24A 212
      K=-IR(I)                                                          B24A 213
      IC(I)=FAMOA(K)                                                    B24A 214
  416 IM(I)=FAMOB(K)                                                    B24A 215
 417  FORMAT(///5X9HELEMENT  ,18A4)
  418 FORMAT( 5X9HBASE SP   6(4X2A4))                                   B24A 219
      GO TO 372                                                         B24A 220
  369 DO 361 L=1,IS                                                     B24A 221
      VNU(II,L)=0.                                                      B24A 223
      DO 361 I=1,IS                                                     B24A 224
  361 VNU(II,L)=VNU(II,L)+C(I)*UM(L,I)                                  B24A 225
      LAMI(II)=LAMKK
  370 KK=II                                                             B24A 226
      II=II+1                                                           B24A 227
      YC= 0.                                                            B24A 228
 372  READ(KIN,302) (RA(K),RB(KK,K), RC(KK,K), RD(KK,K), RE(KK,K),
     1RF(KK,K), ZIGEPS(K), TU(KK,K),KPHA(K),K=1,2)
      IF(KPHA(1)-KPHA(2)) 3733,3736,3734
 3733 IF(KPHA(1)+KPHA(2)-5) 3734,3737,3734
 3734 WRITE(KOUT,3735) AMOA,AMOB
 3735 FORMAT(////25H BAD PHASE NUMBERING FOR 2A4)
      STOP
 3736 IF(KPHA(1)-1) 3734,3727,3728
 3737 TU(KK,1)=-TU(KK,1)
 3728 FF(KK) = 1.E+10
      GG(KK) = 1.E+10
      GO TO 3729
 3727 FF(KK)=(WT/FITMOL) **FFA
      IFMET(KK)=2
      GG(KK) = -1.
 3729 IF(NFF) 3726,3449,3730
 3730 DO 3723 I=1,NFF                                                   B24A 233
      IF(NFIA(I)-AMOA) 3723,3724,3723                                   B24A 234
 3724 IF(NFIB(I)-AMOB) 3723,3720,3723
 3720 IF(FFIN(I)-100.) 3725,3731,3731
 3725 IF (FFIN(I)) 3480,3480,3481
 3480 GG(KK) = -FFIN(I)
       GMET(KK)=1
      GO TO 3723
 3481 FF(KK) = FFIN(I)
      IFMET(KK)=1
      GO TO 3723
 3731 TF(KK)=FFIN(I)
 3723 CONTINUE
      IF (GG(KK)) 3449,3449,3455
 3449 IF (ZIGEPS(1)-100.) 3453,3452,3452
 3453 IF  (ZIGEPS(1)) 3452,3452,3441
 3441 IF (ZIGEPS(2)) 3452,3452,3443
 3443 GG(KK) = ZIGEPS(1)/SIGMA  *  (ZIGEPS(2)/EPOVRK)**.0795   *
    1  (WT/BASMOL)**.25
      IGMET(KK)=3
      GO TO 3455
 3452 IF (KPHA(1)-1)3456,3457,3456
 3456 GG(KK) = 1.E+10
      GO TO 3455
 3457 GG(KK) = (WT/FITGMW)**GGA
      IGMET(KK)=2
 3455 CONTINUE
 3726 IF(KR(3)-6) 3722,3721,3722                                        B24A 243
```

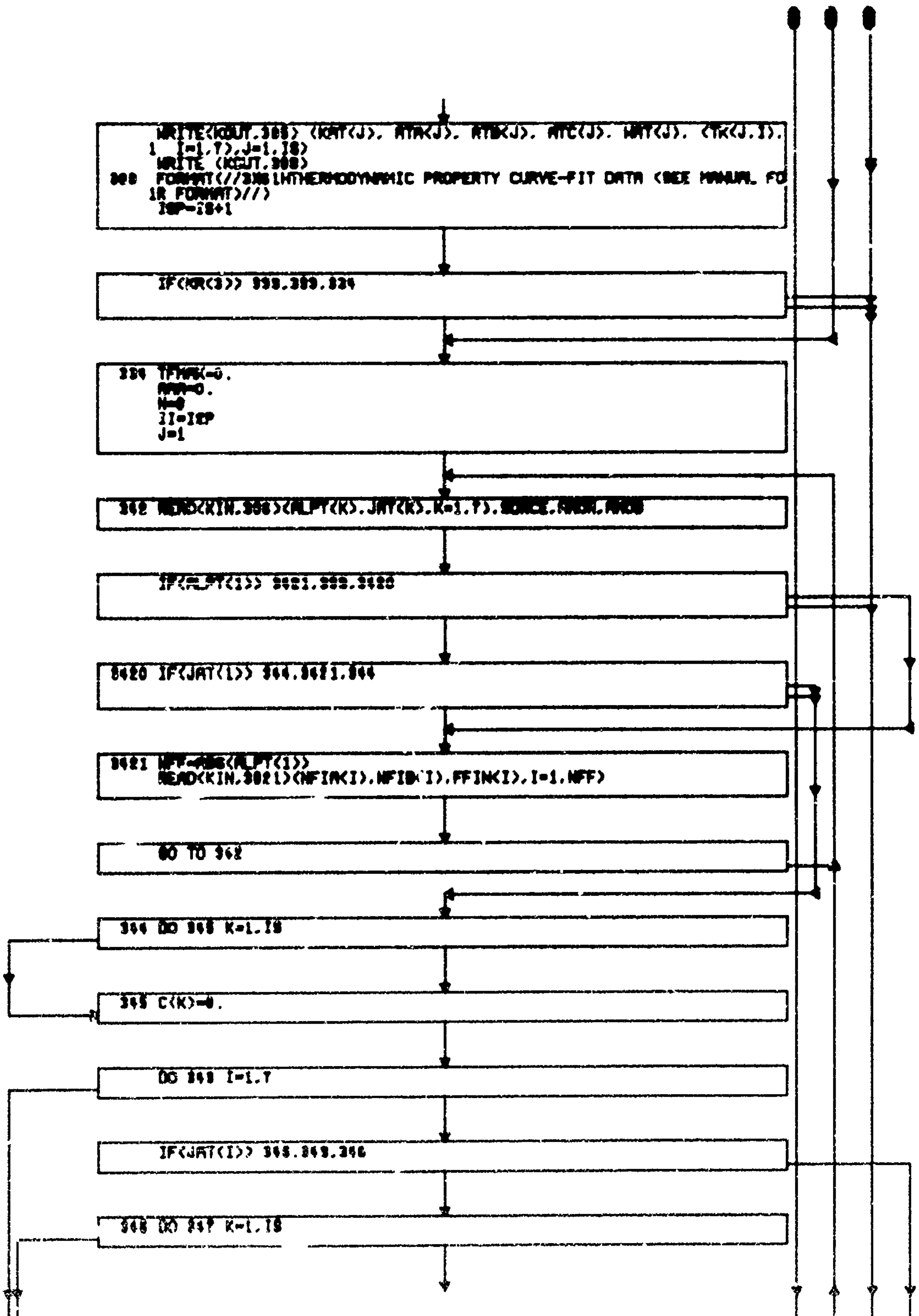
```
3721 WRITE(KOUT,306)(ALPT(K),JAT(K), K=1,7), SORCE,AMOA,AMOB
     WRITE(KOUT,3020)(RA(K), RB(KK,K), RC(KK,K), RD(KK,K), RE(KK,K),
    1RF(KK,K),ZIGEPS(K),TU(KK,K),KPHA(K),K=1,2)
3722 FAMOA(KK)=AMOA                                                  B24A 247
     FAMOB(KK)=AMOB                                                  B24A 248
     WTM(KK)=WT                                                      B24A 251
     RB(KK,1)= RB(KK,1) + RA(1)
     RB(KK,2) = RB(KK,2) + RA(2)
     N=N+1                                                           B24A 254
     IF(KPHA(1)-1)3734,362,364
 364 IFC(KK)=-1                                                      B24A 267
     VN(KK)=0.                                                       B24A 268
     Y(KK)=YC                                                        B24A 269
     IF(TF(KK)-TFMAX) 342,342,371                                    B24A 270
 371 TFMAX=TF(KK)                                                    B24A 271
     GO TO 342                                                       B24A 272
 362 IFC(KK)=0                                                       B24A 273
     VN(KK)=VINT                                                     B24A 274
     Y(KK)=YINT                                                      B24A 275
     GO TO 342                                                       B24A 276
399  WRITE (KOUT,417) (ATA(I),ATB(I),ATC(I),I=1,IS)
     WRITE (KOUT,418) (IC(I),IM(I),I=1,IS)
5005 WRITE(KOUT,110) SIGMA,EPOVRK,BASMOL
110  FORMAT(///3X30HMOLECULAR TRANSPORT PROPERTIES/5X75HVISCOSITY .....
    1 BUDDENBERG - WILKE MIXTURE FORMULA WITH MU(I) CALCULATED ON/21X34
    2HTHE BASIS OF D(I,I) = DBAR/G(I)**2//5X80HTHERMAL CONDUCTIVITY ...
    3., MASON - SAXENA MIXTURE FORMULA WITH EUCKEN CORRECTION//5X73HDIF
    4FUSION COEFFICIENTS ..... D(I,J) = DBAR/(F(I)*F(J)) WITH DBAR BASE
    5D ON/21X8HSIGMA = ,F8.4,11H, EPOVRK = ,F9.4,13H, AND MREF = ,F8.4)
     WRITE (KOUT,111) FITMOL,FFA,FITGMW,GGA
111  FORMAT(//7X16HMETHODS EMPLOYED//8X63H0 CONDENSED PHASE, VALUES FOR
    1 F(I) AND G(I) SET EQUAL TO 1.E+10//8X42H1 VALUES FOR F(I) (OR G(I
    2)) INPUT DIRECTLY//8X71H2 VALUES FOR F(I) (OR G(I)) CALCULATED BY
    3 F(I) =(M(I)/FITMOL)**FFA AND/10X43HG(I) = (M(I)/FITGMW)**GGA WHER
    4E M(I) IS SPECIES MOLECULAR WEIGHT,/10X,9HFITMOL = ,F8.4,12H, AND
    5FFA = ,F6.4,11H, FITGMW = F8.4,12H, AND GGA = ,F6.4)
     WRITE (KOUT,112)
112  FORMAT(/8X79H3 VALUES FOR G(I) CALCULATED BY G(I) = SQRT(DBAR/D(I,
    1I)) = (SIGMA(I)/SIGMA)     /10X73H* (EPS(I)/EPOVRK) **0.0795 * (M(I
    2)/MREF) **0.25 WHERE SIGMA(I) AND EPS(I)/10X33HARE GIVEN WITH THER
    3MODYNAMIC DATA//7X73HSPECIES   F(I) METHOD G(I) METHOD        SPECI
    4ES   F(I) METHOD G(I) METHOD)
     WRITE (KOUT,113 )(FAMOA(KK),FAMOB(KK),FF(KK),IFMET(KK),GG(KK),IGME
    1T(KK)),KK=1,N)
113  FORMAT(7X,2A4,1X,F5.3,3X,I1,3X,F9.3,3X,I1,10X,2A4,1X,F5.3,3X,I1,3X
    1,F5,3,3X,I1)
     WRITE (KOUT,419)
419  FORMAT (//3X61HS..GNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE
    1 EXPANSION/)
     DO 375 L=1,7
     DO 375 I=1,IS                                                   B24A 278
     TQ(I,L)=0.                                                      B24A 279
     DO 375 K=1,IS                                                   B24A 280
 375 TQ(I,L)=TQ(I,L)+UM(I,K)*TK(K,L)                                 B24A 281
     IF(KR(2)-5) 3752,3752,3751
3751 CONTINUE
 240 FORMAT(8F10.6)                                                  THER1330
 245 FORMAT (2I3)                                                    THER1340
 250 FORMAT(3E10.4)                                                  THER1350
 255 READ(KIN,245)NT                                                 THER1370
```

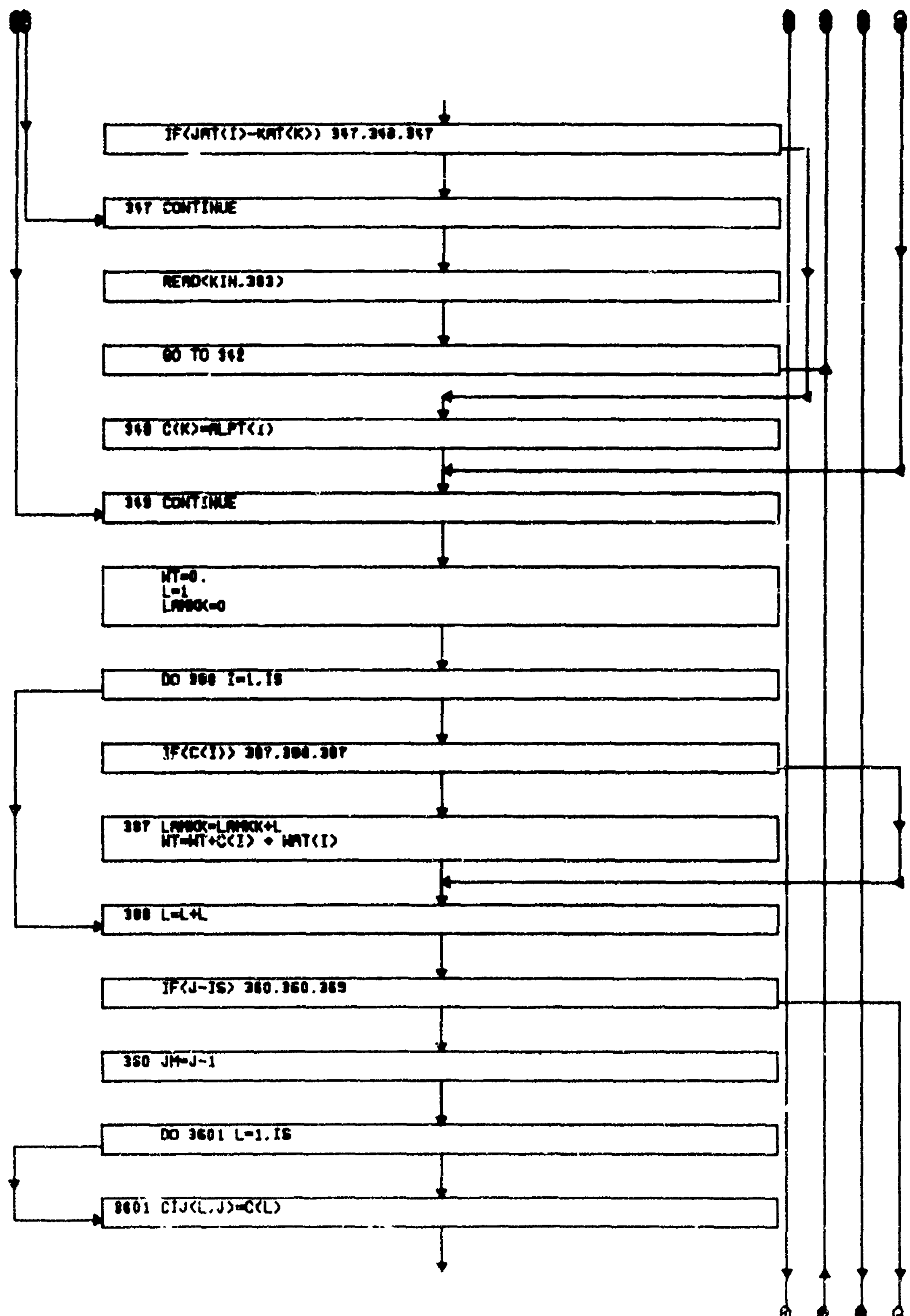
```
      IF(MT) 3752,3752,256
  256 DO 260 M=1,MT
      READ(KIN,230)FKF(M),EAK(M),EXK(M)
      READ(KIN,240)(RMU(I,M),I=1,18)
  260 READ(KIN,240)(PMU(I,M),I=1,18)
  265 FORMAT (//3X,7HKINETIC)
  270 FORMAT (3X,11HREACTION---,I7,9I10)
  275 FORMAT (/3X,8HREACTANT)
  280 FORMAT (5X,12HCOEFFICIENTS/)
  285 FORMAT (8X,2A4,F8.2,9F10.2)
  290 FORMAT (/3X,7HPRODUCT)
  295 FORMAT (/3X,12HPRE-EXPONENT)
  200 FORMAT (5X,6HFACTOR,4X,10E10.3)
  205 FORMAT (/3X,10HACTIVATION)
  210 FORMAT (5X,6HENERGY,4X,10E10.3)
  215 FORMAT (/3X,8HREACTION)
  220 FORMAT (5X,5HORDER,5X,10E10.3)
      WRITE(KOUT,265)
      WRITE(KOUT,270)(M,M=1,MT)
      WRITE(KOUT,275)
      WRITE(KOUT,280)
      DO 225 I=1,18
  225 WRITE(KOUT,285)FAMOA(I),FAMOB(I),(RMU(I,M),M=1,MT)
      WRITE(KOUT,290)
      WRITE(KOUT,280)
      DO 230 I=1,18
  230 WRITE(KOUT,285)FAMOA(I),FAMOB(I),(PMU(I,M),M=1,MT)
      WRITE(KOUT,295)
      WRITE(KOUT,200)(FKF(M),M=1,MT)
      WRITE(KOUT,205)
      WRITE(KOUT,210)(EAK(M),M=1,MT)
      WRITE(KOUT,215)
      WRITE(KOUT,220)(EXK(M),M=1,MT)
 3752 VN(N+1)=0.
      IFC(N+1)=-1
      WTM(N+1)=-1.
      FAMOA(N+1)=CHAR
      FAMOB(N+1)=BLANK
      TF(N+1)=50000.
      IF(DUB8.GT.0.) TF(N+1) = [illegible]
      RETURN
      END
```

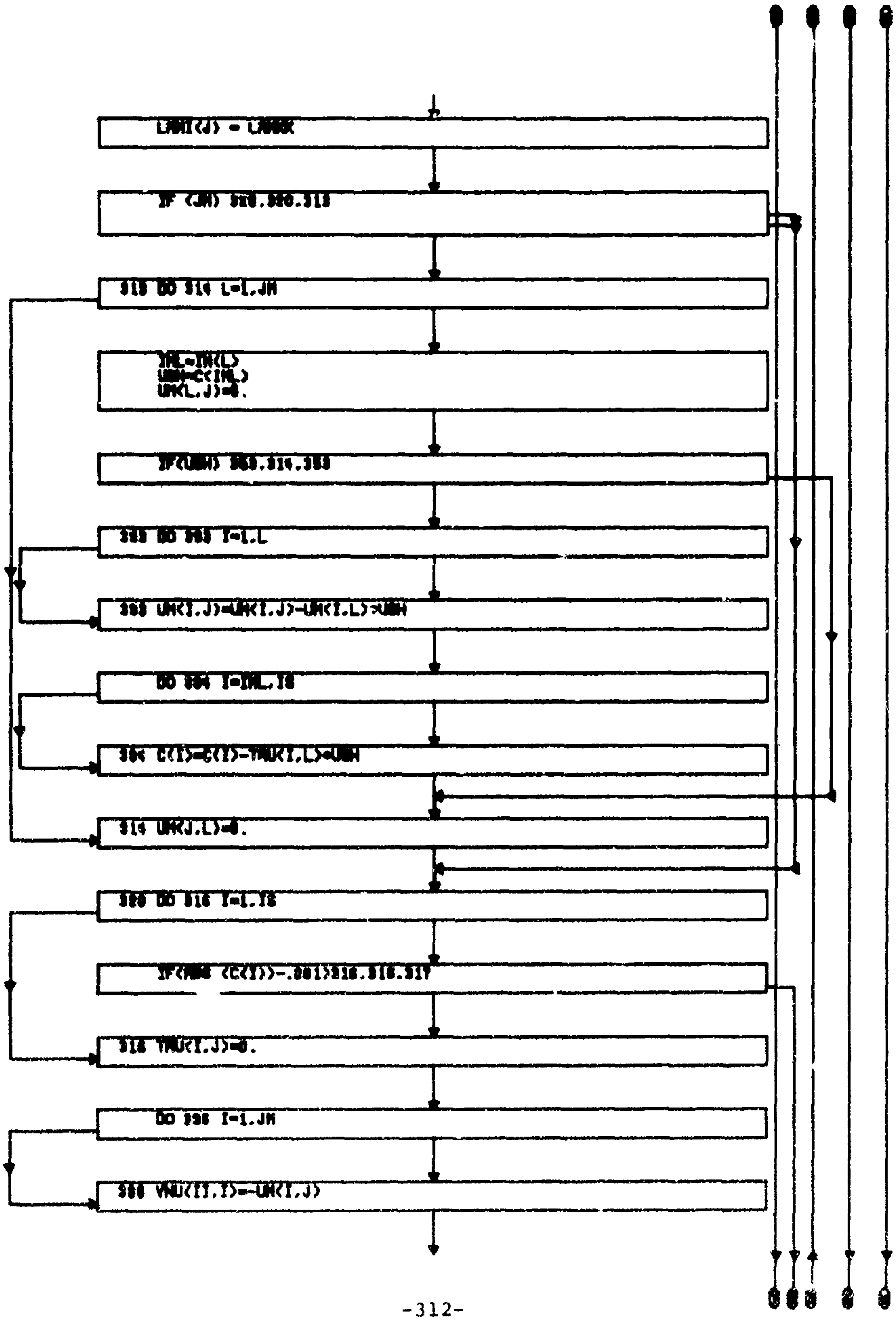
c. Flow Chart

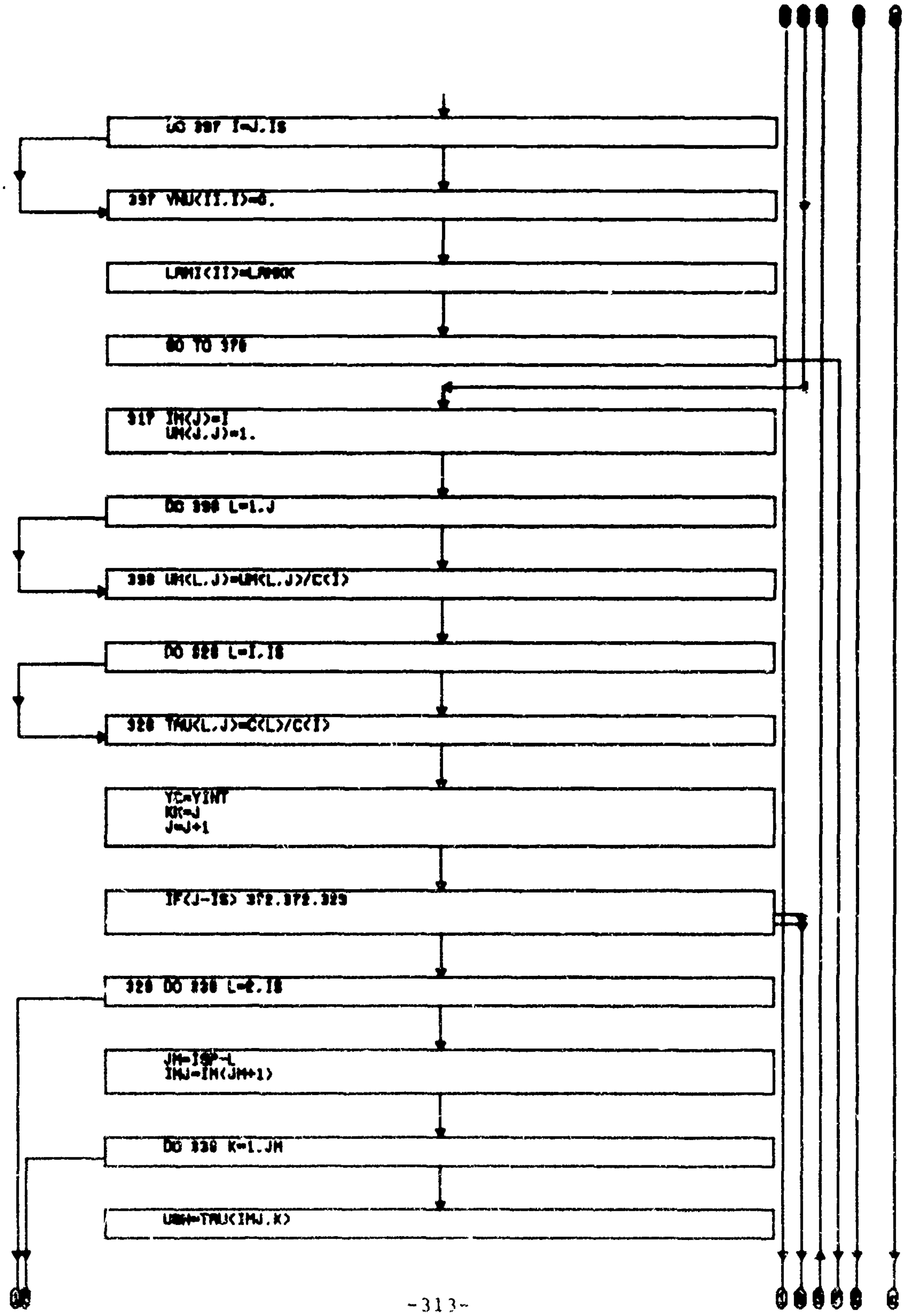

SUBROUTINE INPUT(PP)
DATA CHAR,BLANK/4HCHAR,4H /
P=PP
KR(3)=2
KR(2)=KKR(12)+1
IF(KR(2).EQ.3.OR.KR(2).EQ.8) KR(3)=6
IF(KR(2).EQ.7) GO TO 3751
FFA=0.488
FITMOL=28.7
VINT=P+1.E-6
YINT=ALOG(VINT)
IF (KR(2)) 334,334,321
IF (FFAR) 3213,3212,3211
3213 FFA=0.
GO TO 3212
FFA=FFAR
3212 CONTINUE

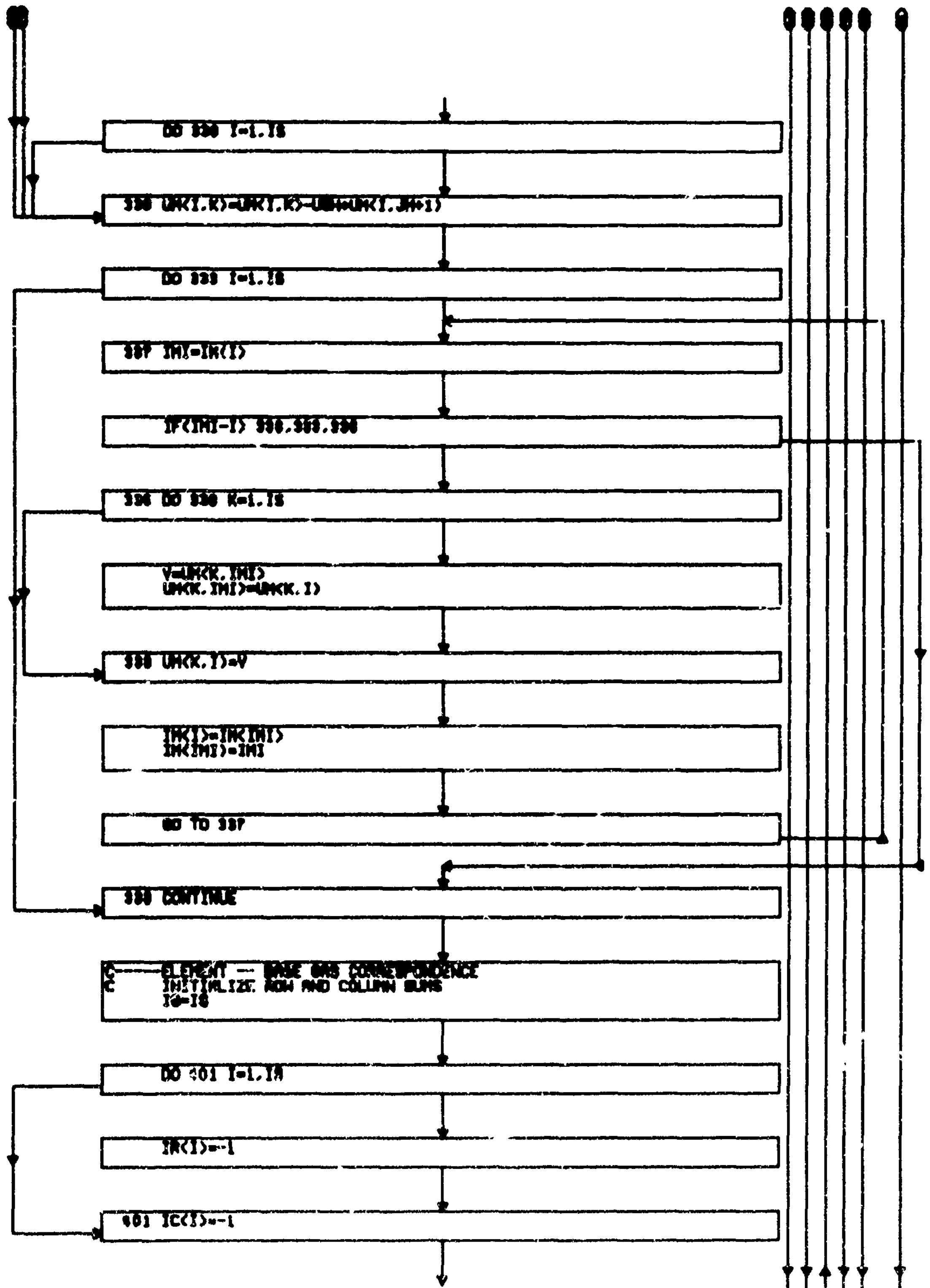

IF (IS-10) 311,311,399
311 READ(KIN,304) (KAT(J), ATA(J), ATB(J), ATC(J), WAT(J), (TK(J,I),
1 I=1,7),J=1,IS)
DO 327 K=1,7
VA=0.
DO 322 J=1,IS
IF(KAT(J)-99) 3111,325,3111
3111 IF(TK(J,K)) 324,322,325
324 VA=VA-TK(J,K)
TK(J,K)=-TK(J,K)/WAT(J)
GO TO 322
325 VA=VA+TK(J,K)*WAT(J)
322 CONTINUE
IF(VA) 326,327,326
326 DO 323 J=1,IS
323 TK(J,K)=TK(J,K)/VA
327 CONTINUE

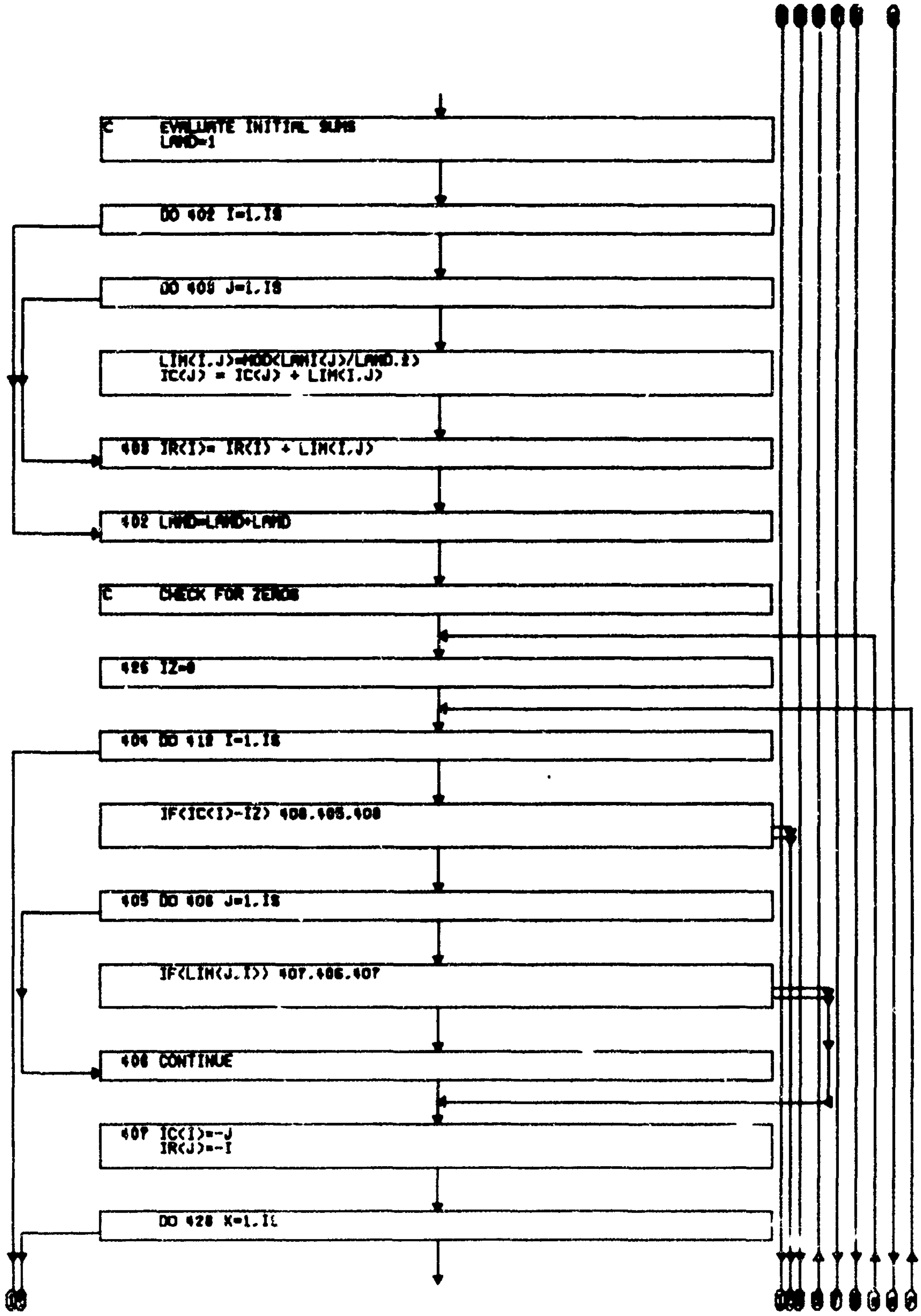

WRITE(KOUT,388) (KAT(J), ATA(J), ATB(J), ATC(J), WAT(J), (TK(J,I),
1 I=1,7),J=1,IS)
WRITE (KOUT,388)
388 FORMAT(//3X61HTHERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FO
1R FORMAT)//)
ISP=IS+1
IF(KR(3)) 338,339,334
334 TFMAX=0.
AMA=0.
N=0
II=ISP
J=1
342 READ(KIN,300)(ALPT(K),JAT(K),K=1,7),
IF(ALPT(1)) 3421,338,3420
3420 IF(JAT(1)) 344,3421,344
3421 NFF=ABS(ALPT(1))
READ(KIN,3021)(NFIA(I),NFIB(I),FFIN(I),I=1,NFF)
GO TO 342
344 DO 345 K=1,IS
345 C(K)=0.
DO 348 I=1,7
IF(JAT(I)) 348,348,346
346 DO 347 K=1,IS

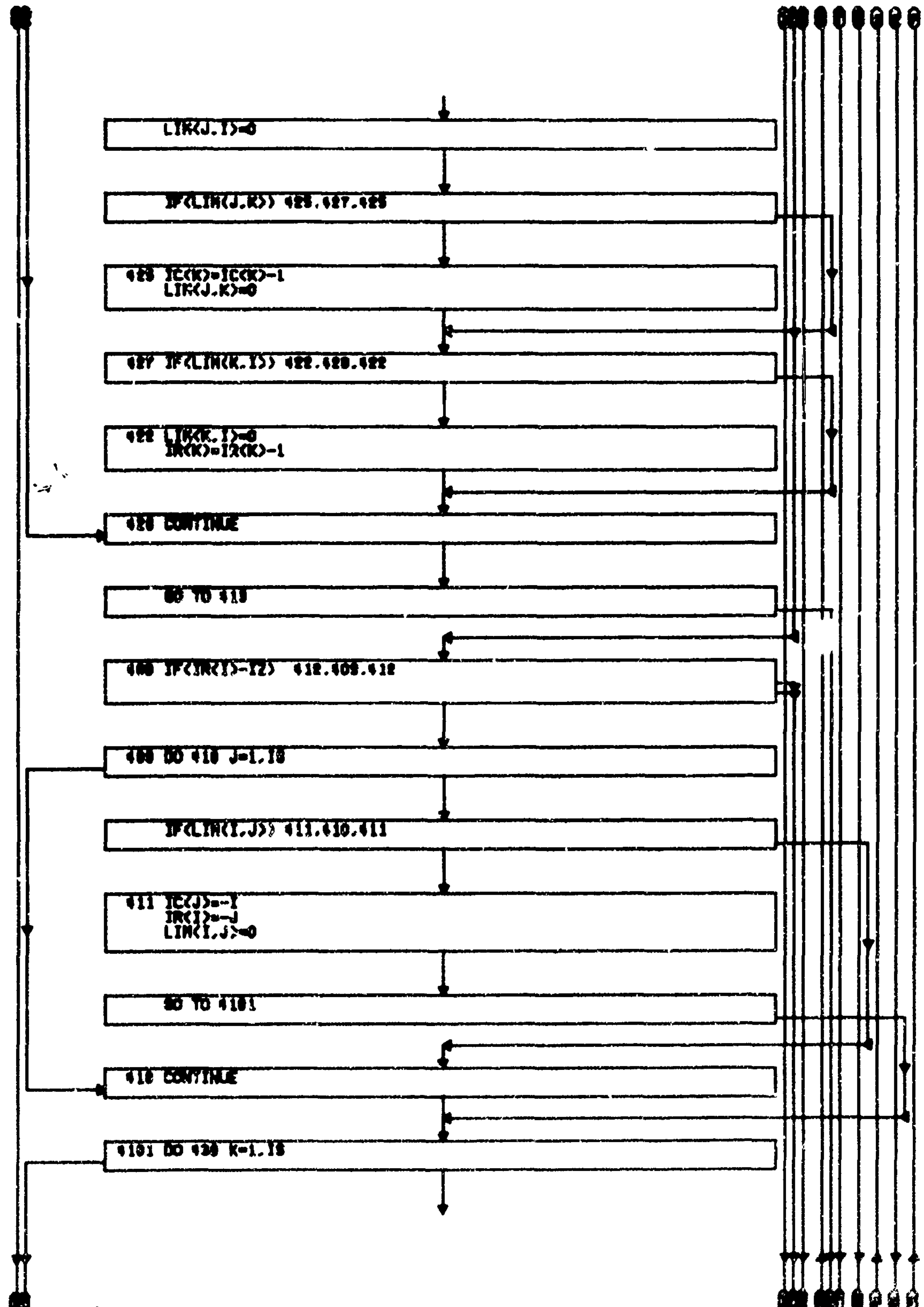

IF(JAT(I)-KAT(K)) 347,348,347
347 CONTINUE
READ(KIN,383)
GO TO 342
348 C(K)=ALPT(I)
349 CONTINUE
WT=0.
L=1
LAMKK=0
DO 388 I=1,IS
IF(C(I)) 387,388,387
387 LAMKK=LAMKK+L
WT=WT+C(I) * WAT(I)
388 L=L+L
IF(J-IS) 360,360,369
360 JM=J-1
DO 3601 L=1,IS
8601 CIJ(L,J)=C(L)

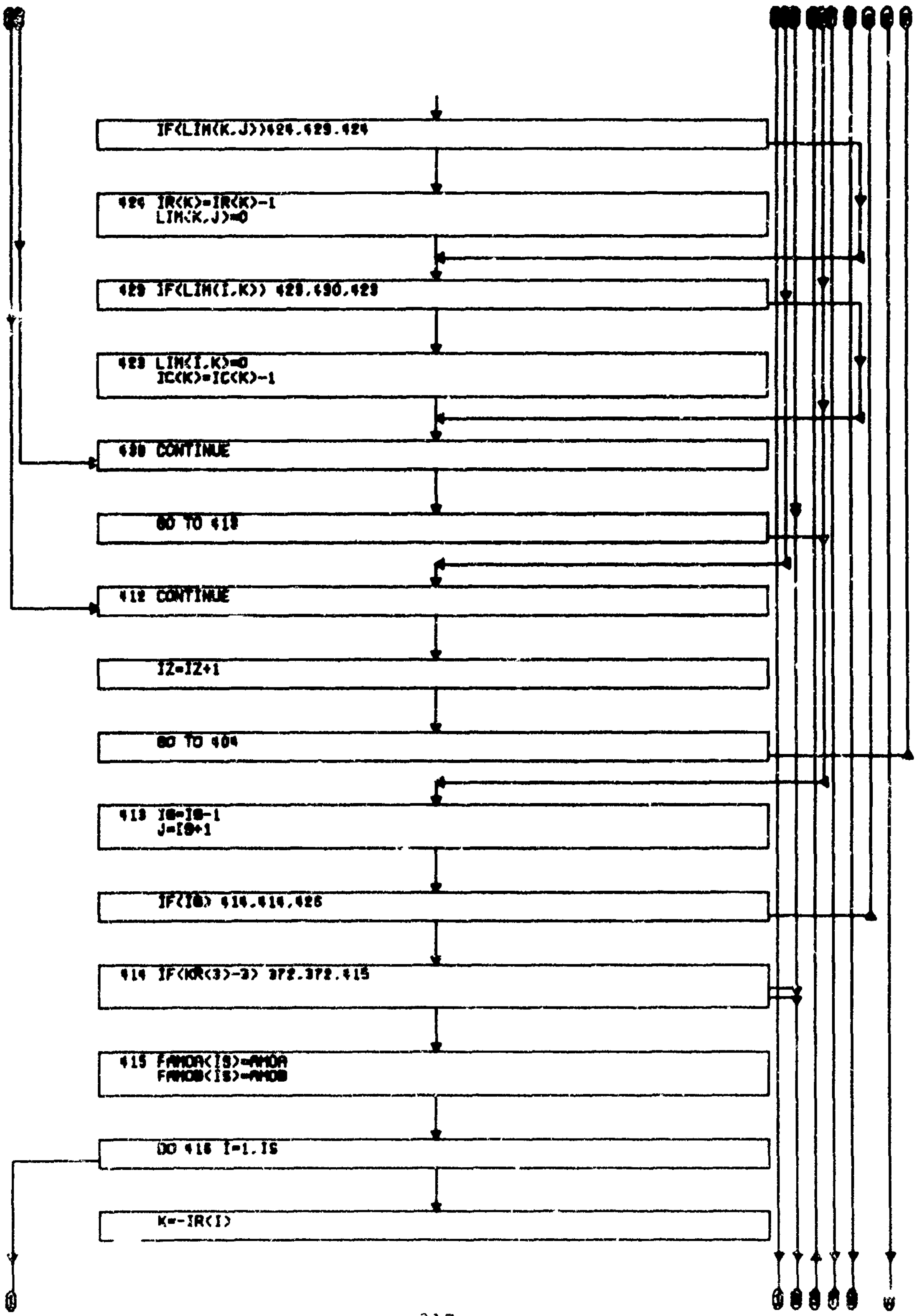

313 DO 314 L=1,JM
314 UM(J,L)=0.
DO 396 I=1,JM

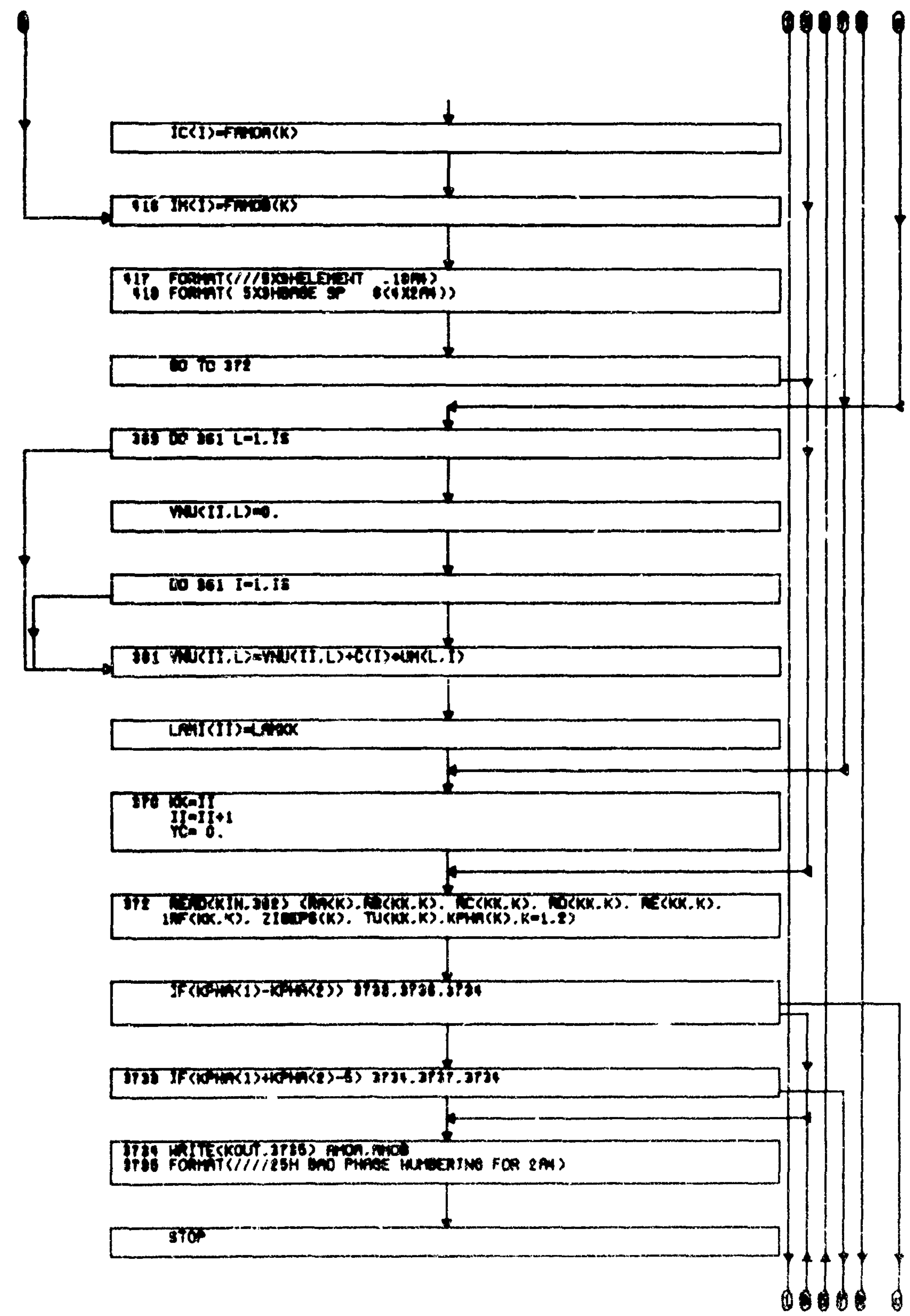

397 VAU(II,I)=0.
GO TO 376
317 IM(J)=I
UM(J,J)=1.
DO 396 L=1,J
396 UM(L,J)=UM(L,J)/C(I)
DO 326 L=I,IS
326 TAU(L,J)=C(L)/C(I)
YC=YINT
KK=J
J=J+1
IF(J-IS) 372,372,329
329 DO 330 L=2,IS
JM=ISP-L
IMJ=IM(JM+1)
DO 330 K=1,JM

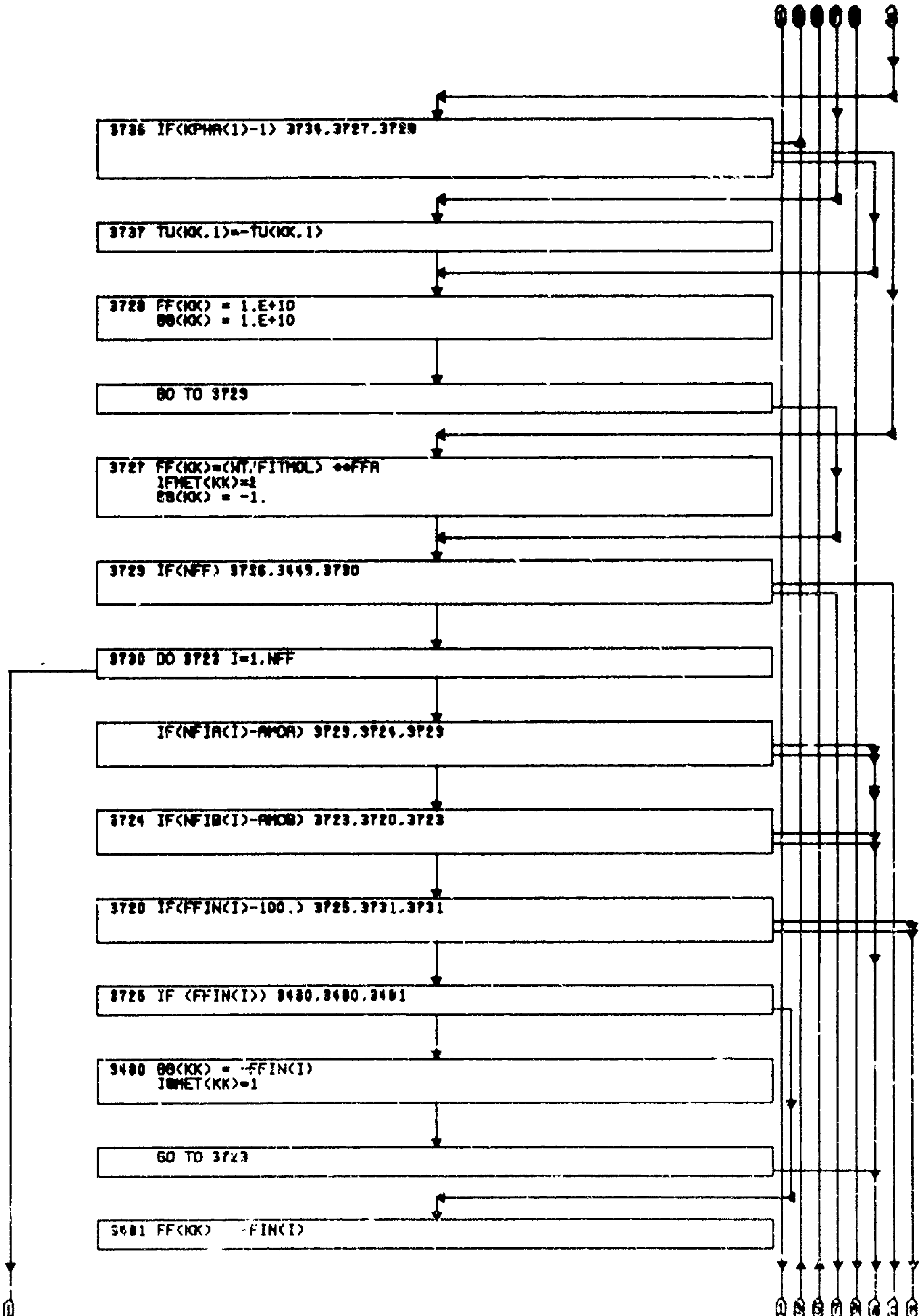

DO 330 I=1,IS
DO 333 I=1,IS
337 IMI=IN(I)
IF(IMI-I) 336,333,336
336 DO 338 K=1,IS
V=UM(K,IMI)
UM(K,IMI)=UM(K,I)
338 UM(K,I)=V
IN(I)=IN(IMI)
IN(IMI)=IMI
GO TO 337
333 CONTINUE
C ELEMENT -- BASE ORB CORRESPONDENCE
C INITIALIZE ROW AND COLUMN SUMS
DO 401 I=1,IR
IR(I)=-1
401 IC(I)=-1


C EVALUATE INITIAL SUMS
LAND=1
DO 402 I=1,IS
DO 403 J=1,IS
LIM(I.J)=MOD(LAMI(J)/LAND.2)
IC(J) = IC(J) + LIM(I.J)
403 IR(I)= IR(I) + LIM(I,J)
402 LAND=LAND+LAND
C CHECK FOR ZEROS
426 IZ=0
404 DO 412 I=1,IS
IF(IC(I)-IZ) 408.405.408
405 DO 406 J=1,IS
IF(LIM(J,I)) 407.406.407
406 CONTINUE
407 IC(I)=-J
IR(J)=-I
DO 428 K=1,IL

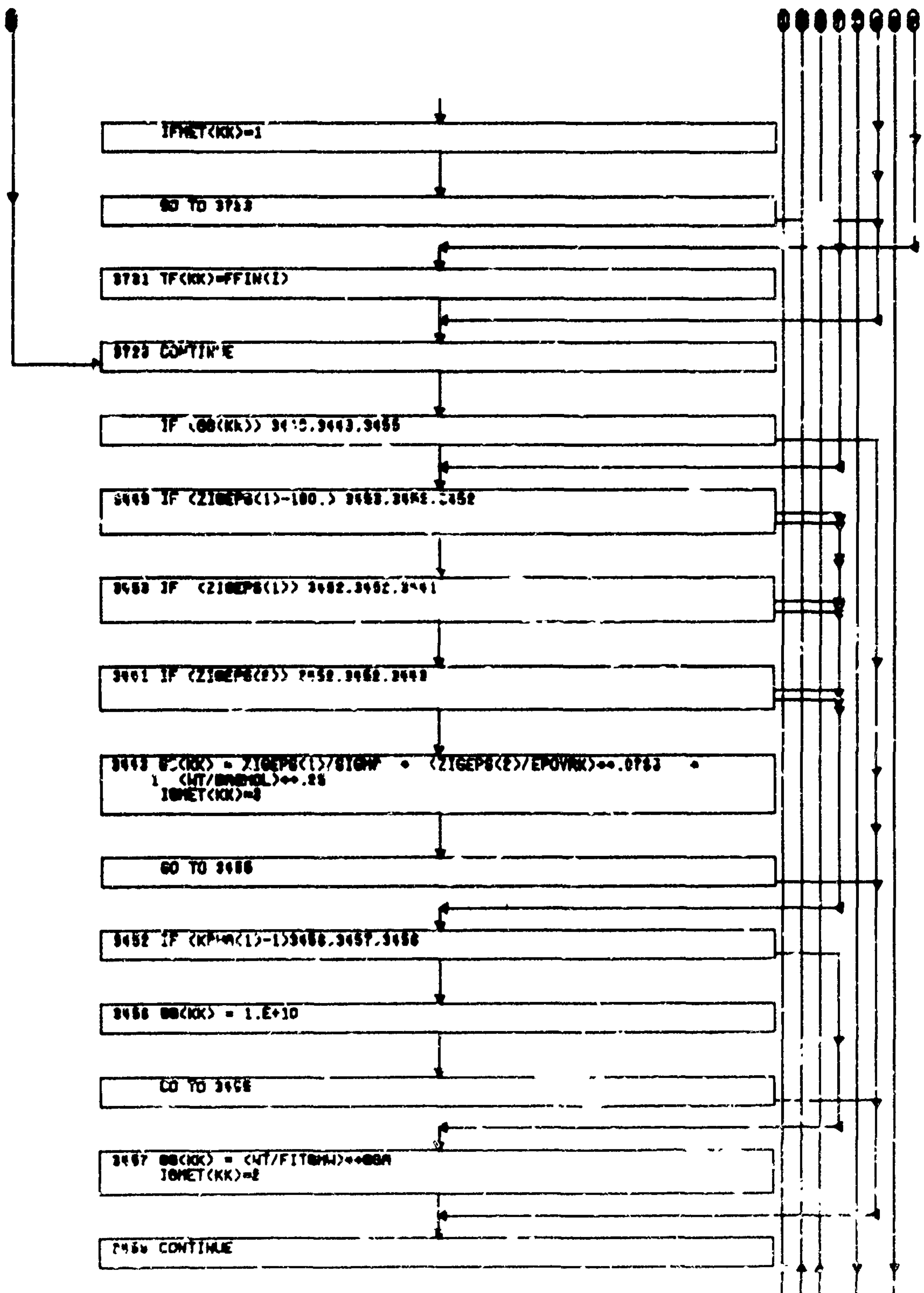

LIN(J,I)=0
IF(LIN(J,K)) 425,427,425
425 IC(K)=IC(K)-1
LIN(J,K)=0
427 IF(LIN(K,I)) 422,420,422
422 LIN(K,I)=0
IR(K)=IR(K)-1
420 CONTINUE
GO TO 415
IF(IR(I)-I2) 412,408,412
DO 410 J=1,I8
IF(LIN(I,J)) 411,410,411
411 IC(J)=-I
IR(I)=-J
LIN(I,J)=0
GO TO 4101
410 CONTINUE
4101 DO 430 K=1,I8


IF(LIM(K,J))424,429,424
424 IR(K)=IR(K)-1
LIM(K,J)=0
429 IF(LIM(I,K)) 428,430,428
428 LIM(I,K)=0
IC(K)=IC(K)-1
430 CONTINUE
GO TO 413
412 CONTINUE
IZ=IZ+1
GO TO 404
413 IS=IS-1
J=IS+1
IF(IS) 414,414,426
414 IF(KR(3)-3) 372,372,415
415 FAMDA(IS)=AMDA
FAMDB(IS)=AMDB
DO 416 I=1,IS
K=-IR(I)

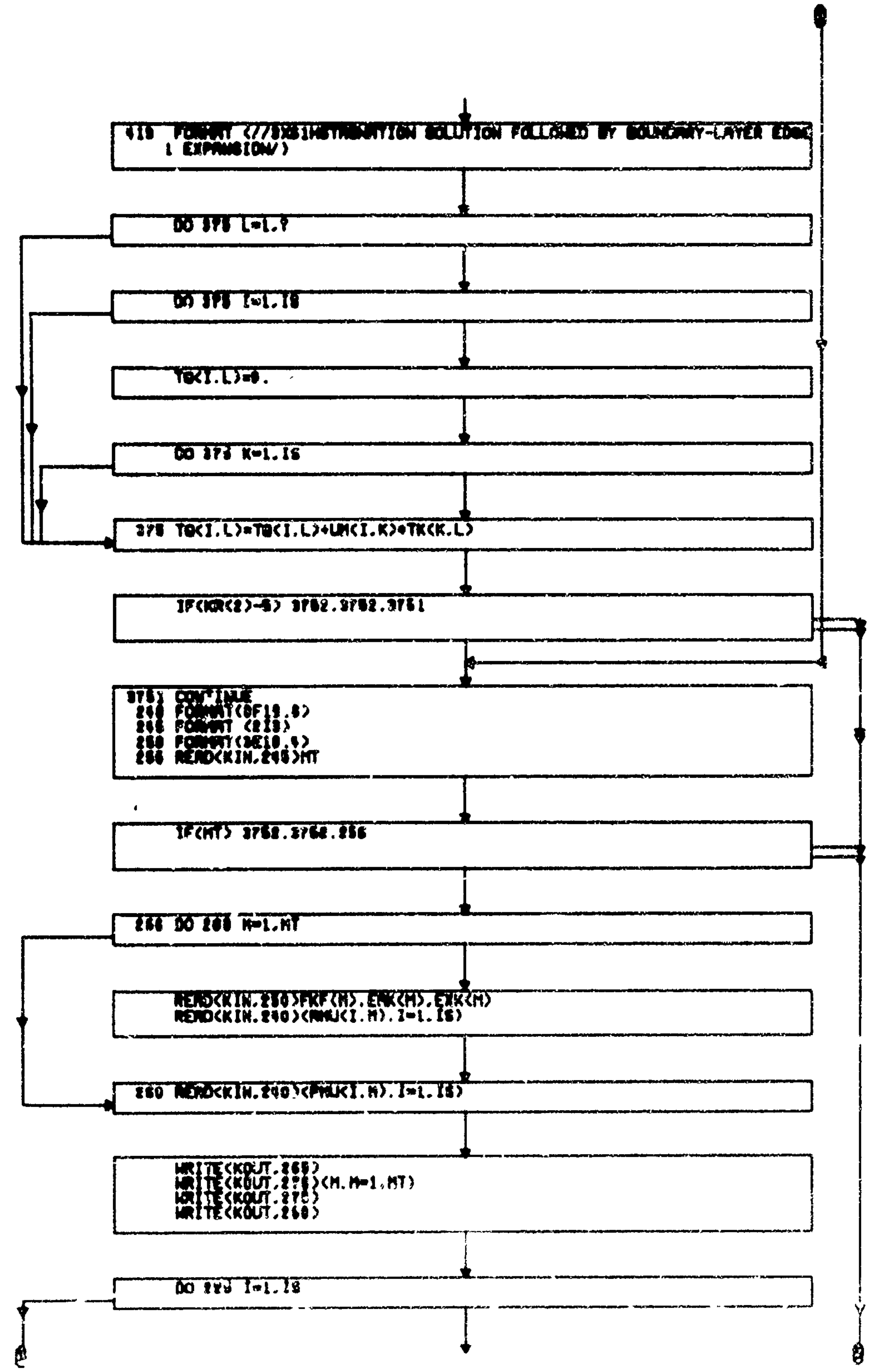

IC(I)=FAMOA(K)
416 IM(I)=FAMOB(K)
417 FORMAT(///9X9HELEMENT .10A4)
419 FORMAT(5X9HBASE SP 8(4X2A4))
GO TO 372
389 DO 361 L=1.IS
VNU(II.L)=0.
DO 361 I=1.IS
361 VNU(II.L)=VNU(II.L)+C(I)*UM(L.I)
LAMI(II)=LAMXX
370 KK=II
II=II+1
YC= 0.
372 READ(KIN.302) (RA(K).RB(KK.K). RC(KK.K). RD(KK.K). RE(KK.K).
1RF(KK.K). ZIBEPS(K). TU(KK.K).KPHA(K).K=1.2)
IF(KPHA(1)-KPHA(2)) 3733.3736.3734
3733 IF(KPHA(1)+KPHA(2)-5) 3734.3737.3734
3734 WRITE(KOUT.3735) AMOA.AMOB
3735 FORMAT(////25H BAD PHASE NUMBERING FOR 2A4)
STOP

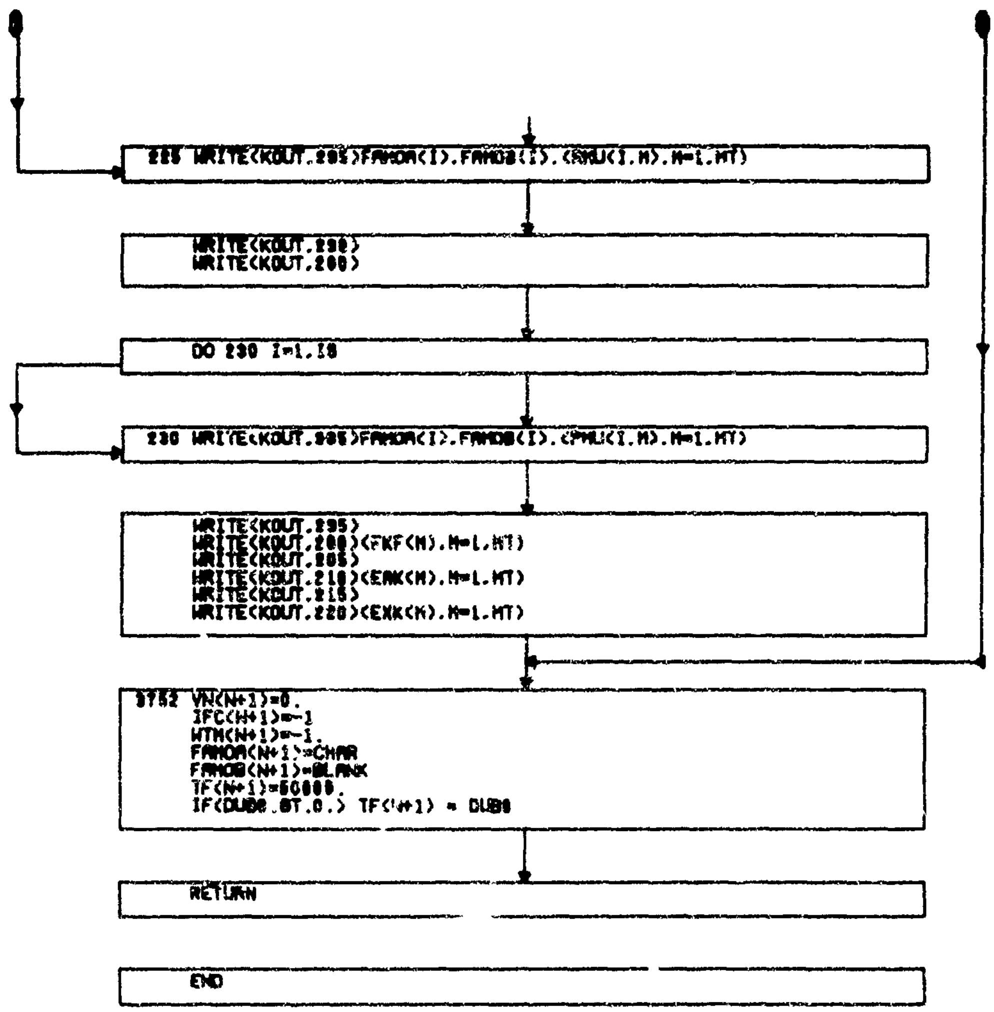


3736 IF(KPHA(1)-1) 3734,3727,3728
3737 TU(KK,1)=-TU(KK,1)
3728 FF(KK) = 1.E+10
BB(KK) = 1.E+10
GO TO 3729
3727 FF(KK)=(WT/FITMOL) **FFA
IFMET(KK)=1
BB(KK) = -1.
3729 IF(NFF) 3726,3449,3730
3730 DO 3723 I=1,NFF
IF(NFIA(I)-AMOA) 3723,3724,3723
3724 IF(NFIB(I)-AMOB) 3723,3720,3723
3720 IF(FFIN(I)-100.) 3725,3731,3731
3725 IF (FFIN(I)) 3480,3480,3481
3480 BB(KK) = -FFIN(I)
IBMET(KK)=1
GO TO 3723
3481 FF(KK) -FIN(I)


IFMET(KK)=1
GO TO 3723
3721 TF(KK)=FFIN(I)
3723 CONTINUE
3452 IF (KP
3456 BB(KK) = 1.E+10
GO TO 3456
3457 BB(KK) = (WT/FITBMW)**BBM
IBMET(KK)=2
CONTINUE

```
3726 IF(KR(3)-6) 3722,3721,3722

3721 WRITE(KOUT,308)(ALPT(K),JAT(K), K=1,7), SORCE,AMOA,AMOB
     WRITE(KOUT,3880)(RA(K), RB(KK,K), RC(KK,K), RD(KK,K), RE(KK,K),
    1RF(KK,K),ZIGEPS(K),TU(KK,K),KPHA(K),K=1,2)

3722 FAMOA(KK)=AMOA
     FAMOB(KK)=AMOB
     WTM(KK)=WT
     RB(KK,1)= RB(KK,1) + RA(1)
     RB(KK,2) = RB KK,2) + RA(2)
     N=N+1

     IF(KPHA(1)-1)3734,362,364

364  IFC(KK)=-1
     VN(KK)=0.
     Y(KK)=YC

     IF(TF(KK)-TFMAX) 342,342,371

371  TFMAX=TF(KK)

     GO TO 342

362  IFC(KK)=0
     VN(KK)=VINT
     Y(KK)=YINT

     GO TO 342

333  WRITE (KOUT,417) (ATA(I),ATB(I),ATC(I),I=1,IS)
     WRITE (KOUT,416) (IC(I),IM(I),I=1,IS)
6001 WRITE(KOUT,110) SIGMA,EPOVRK,BASMOL
     WRITE (KOUT,111) FITMOL,FFA,FITGMX,BBA
     WRITE (KOUT 112)
     WRITE (KOUT,113)((FAMOA(KK),FAMOB(KK),FF(KK),IFMET(KK),BB(KK),IGME
    1T(KK)) KK=1,N)
113  FORMAT(7X,2A4,1X,F5.3,3X,I1,3X,F5 3,3X,I1,10X,2A4,1X,F5.3,3X,I1,3X
    1,F5.3,3X,I1)
     WRITE (KOUT,419)
```


410 FORMAT (//5X51HSTAGNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE
1 EXPANSION/)
DO 375 L=1,7
DO 375 I=1,IS
TQ(I,L)=0.
DO 375 K=1,IS
375 TQ(I,L)=TQ(I,L)+UM(I,K)*TK(K,L)
IF(KR(2)-5) 3752,3752,3751
3751 CONTINUE
240 FORMAT(8F10.5)
245 FORMAT (2I3)
250 FORMAT(3E10.4)
255 READ(KIN,245)MT
IF(MT) 3752,3752,256
256 DO 260 M=1,MT
READ(KIN,250)FKF(M),ENK(M),EXK(M)
READ(KIN,240)(RMU(I,M),I=1,IS)
260 READ(KIN,240)(PMU(I,M),I=1,IS)
WRITE(KOUT,265)
WRITE(KOUT,270)(M,M=1,MT)
WRITE(KOUT,275)
WRITE(KOUT,260)
DO 290 I=1,IS


225 WRITE(KOUT.295)FAMOA(I).FAMOB(I).(RMU(I.M).M=1.MT)
WRITE(KOUT.290)
WRITE(KOUT.200)
DO 230 I=1.I8
230 WRITE(KOUT.295)FAMOA(I).FAMOB(I).(PMU(I.M).M=1.MT)
WRITE(KOUT.295)
WRITE(KOUT.200)(FKF(M).M=1.MT)
WRITE(KOUT.205)
WRITE(KOUT.210)(EAK(M).M=1.MT)
WRITE(KOUT.215)
WRITE(KOUT.220)(EXK(M).M=1.MT)
3752 VN(N+1)=0.
IFC(N+1)=-1
WTM(N+1)=-1.
FAMOA(N+1)=CHAR
FAMOB(N+1)=BLANK
TF(N+1)=50000.
IF(DUB0.GT.0.) TF(N+1) = DUB0
RETURN
END

26. SUBROUTINE PROPS - B25A

a. Function

Computes all properties and property derivatives required by boundary layer calculations. Called by EQUIL.

b. Listing

```
      CB25A                                                             B25A 001
      SUBROUTINE PROPS                                                  B25A 002
      INTEGER FAMOA,FAMOB                                               B25A 004
      DIMENSION  VK(10),PA(12,12),PV(11,12)                             B25A 005*NEW
      COMMON /BLQCOM/FAMOA( 71),FAMOB( 71),N     ,FR( 71,15),W(3),LEF(10)B25A    5*NEW
     1,LEFH(10),PIFASF,LEFW(10)                                         B25A    6*NEW
      COMMON/FDGCOM/              PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,B25A    7*NEW
     1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,WE,C90   B25A    8*NEW
     2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                    B25A    9*NEW
      COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B25A   10*NEW
     1 YU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),   B25A   11*NEW
     2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),         B25A   12*NEW
     3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),Y( 71),YW( 71),GG( 71)  B25A   13*NEW
     4 ,TG(10, 7),EPOVRK,SIGMA,BASMOL                                   B25A   14*NEW
      COMMON /EQTCOM/SIP,HIP,FL,ENL,FLIQ,CPF,IRE,IER,AA,IYS,IN,IL,IT,   B25A   15*NEW
     1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPQ,   B25A   16*NEW
     2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,WG,  B25A   17*NEW
     3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),      B25A   18*NEW
     4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B25A   19*NEW
     5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUS(10),       B25A   20*NEW
     6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)                     B25A   21*NEW
      COMMON /INTCOM/KKR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,II,  B25A   22*NEW
     1ISS,NS,ITT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL,MITS,KAPPA,CBAR,   B25A   23*NEW
     2CASE(15),BB(8),  MWE,NON,KD(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,   B25A   24*NEW
     3 KR9(40),KAUXO,JTIME,JSPEC,MD(3)                                  B25A   25*NEW
      COMMON /PRPCOM/PR(15),TT(15),RHO(15),SC(15),CAPC(15),QR(15),HH(15)B25A   26*NEW
     1,CPRAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB25A   27*NEW
     2MU3K( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B25A   28*NEW
     3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)   B25A   29*NEW
     4,DPHIKK( 8, 8),      DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL   B25A   30*NEW
     5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B25A   31*NEW
     6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),QMR(15)  B25A   32*NEW
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         B25A   33*NEW
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IPW,ISPW,IRHOVW,IFLUXJ      B25A   34*NEW
      DIMENSION PRP(1)                                                        *-31
      EQUIVALENCE (PRP(1),PV(1))
      IF(II-1) 310,300,310                                              B25A 032
  300 IF(KKR(14)-10) 310,302,302                                        B25A 033
  302 KKR(14)=KKR(14)-10                                                B25A 034
  310 IF(T-300,001) 312,312,320                                         B25A 035
  312 KKR(14)=KKR(14)+10                                                B25A 036
  320 WM=AA/P
      ISV=IS                                                            B25A 038
      IS=NSF                                                            B25A 039
      ISVP=ISV+1                                                        B25A 040
  543 ISV2=ISV+2
      CT=-0,5                                                           B25A 041
      ISM=IS-1                                                          B25A 042
      ISP=IS+1                                                          B25A 043
      ISP2=IS+2                                                         B25A 044
      TT(II)=T*1.8                                                      B25A 046
      RHO(II)=AA/(1.3146*T)
      CTR=CT*1.9876                                                     B25A 049
C     FORM NECESSARY SUMMATIONS                                         B25A 051
      PMU2=0.                                                           B25A 052
      CPTIL=0.                                                          B25A 053
      WTG=0.
      HG=0.
```

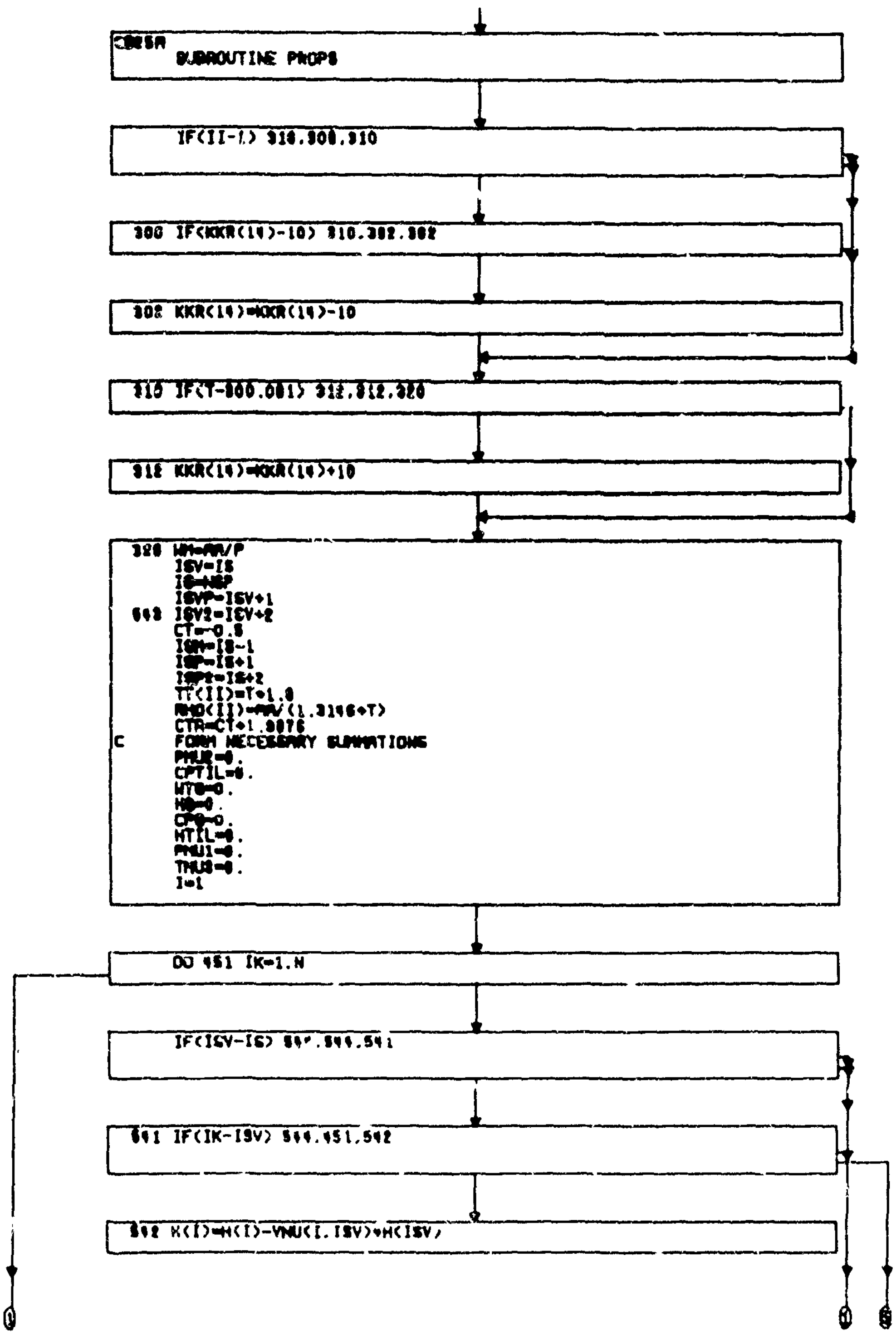
```
      CPG=0.
      HTIL=0.                                                           B25A 054
      PMU1=0.                                                           B25A 055
      TMU3=0.                                                           B25A 056
      I=1
      DO 451 IK=1,N
      IF(ISV-IS) 544,544,541
  541 IF(IK-ISV) 544,451,542
  542 H(I)=H(I)-VNU(I,ISV)*H(ISV)
      WTM(I)=WTM(I)-VNU(I,ISV)*WTM(ISV)
      CP(I)=CP(I)-VNU(I,ISV)*CP(ISV)
  544 IF(IFC(I)) 451,4550,451
 4550 PMU1=PMU1+VN(I)*FF(I)                                             B25A 060
  451 I=I+1
      VMU1=PMU1/P                                                       B25A 062
      AMU5=0.                                                           B25A 063
      PMU6=0.                                                           B25A 064
      WDZ=1.385                                                         B25A 065
      WD4 = 0.284*WDZ
      I = 1
      DO 454 IK = 1,N
      ASTAR = 1.13 * SS(I)/FF(I) + GG(I)/FF(I)
      WD2=1.2*ASTAR/PMU1
      WD7=WDZ/PMU1-WD2
      WD5=.32*ASTAR/PMU1
      WD8=WD4/PMU1-WD5
      VA=VN(I)/FF(I)                                                    B25A 074
      VB=VA*WTM(I)                                                      B25A 075
      VC=VN(I)*FF(I)                                                    B25A 076
      IF(IK-IS) 4510,4510,4560
 4510 VK(I)=0.                                                          B25A 078
      ZK(I)=0.                                                          B25A 079
      IF(IFC(I)) 454,4511,454                                           B25A 080
 4511 VK(I)=VN(I)                                                       B25A 081
  452 ZK(I)=VA                                                          B25A 082
      GO TO 457                                                         B25A 083
 4560 IF(IK-ISV) 454,4562,456
 4562 WTM(I)=0.
      CP(I)=0.
      H(I)=0.
      GO TO 454
  456 IF(IFC(I)) 454,4561,454                                           B25A 085
 4561 DO 453 K=1,ISM                                                    B25A 086
      VK(K)=VK(K)+VN(I)*VNU(I,K)                                        B25A 087
  453 ZK(K)=ZK(K)+VA*VNU(I,K)                                           B25A 088
  457 PMU2=PMU2+VB                                                      B25A 089
      TMU3=TMU3+VA                                                      B25A 090
      CPTIL=VA*CP(I)+CPTIL                                              B25A 091
      HTIL=HTIL+VA*H(I)                                                 B25A 092
      WTG=WTG+VN(I)*WTM(I)
      HG=HG+VN(I)*H(I)
      CPG=CPG+VN(I)*CP(I)
      AMU5=AMU5+VB/(WDZ-VC*WD7)
      PMU6=PMU6+VA/(WD4-VC*WD8)
  454 I=I+1
      VMU5=AMU5/WTG
      VMU6=(PMU6  +CPTIL/1.9869-2.5*TMU3)/P                             B25A 097
      VMU2=PMU2/P                                                       B25A 098
      VMU3=TMU3/PMU2                                                    B25A 099
      CPTIL = CPTIL / PMU2                                              PROP1110
```

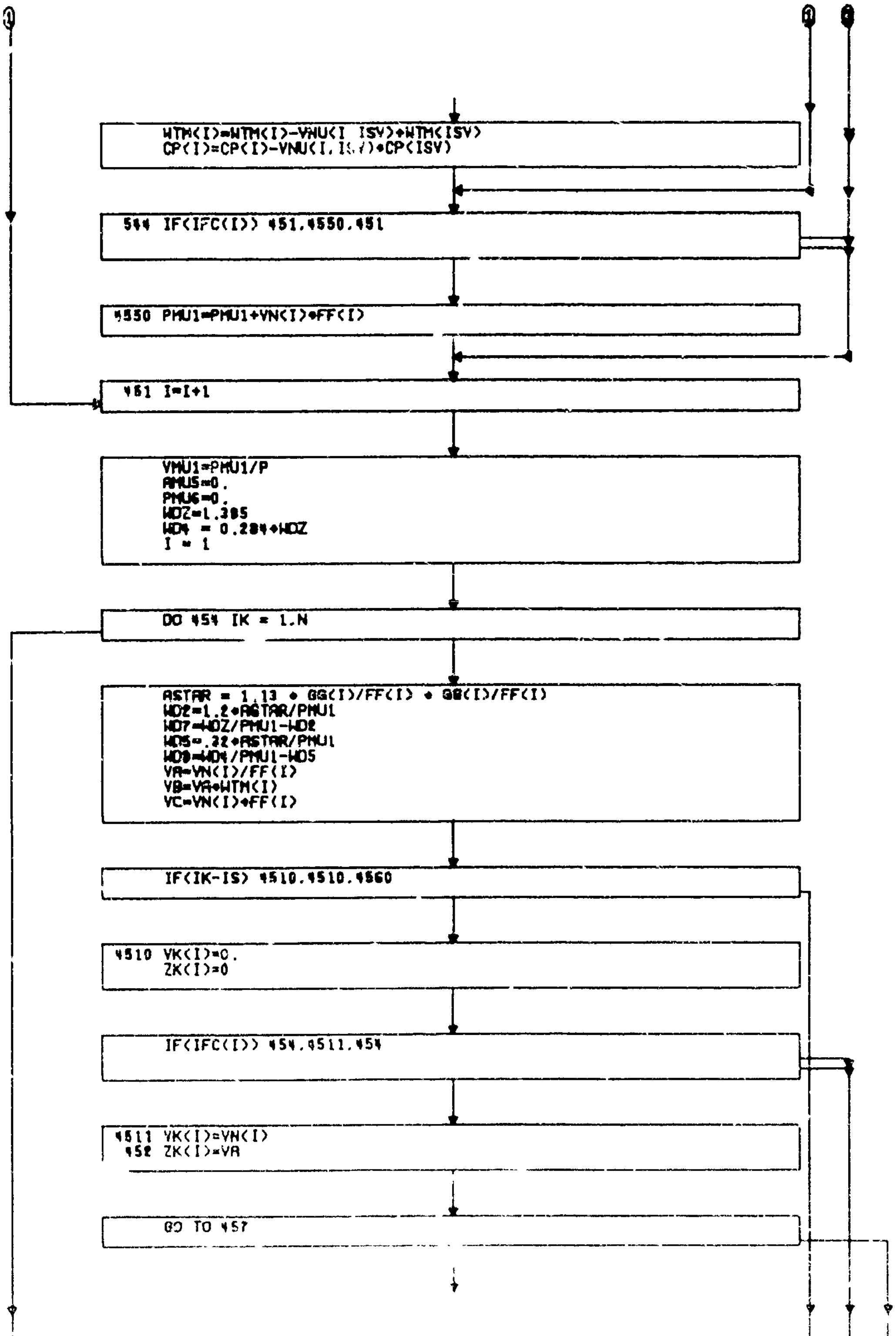
```
      HTIL = HTIL / PMU2 * 1.8                                          PROP1120
      HG=HG/WTG
      CPG=CPG/WTG
      WM=WTG/P
      ZKS = 1.0                                                         PROP1020
      VKS=1.0
      DO 95 K=1,ISM                                                     PROP1030
      VK(K)=VK(K)/WTG*WTM(K)
   95 ZK(K) = ZK(K) / PMU2 * WTM(K)                                     PROP1050
      OMEGA=1.07/(T/EPOVRK) **0.159
      DBAR = 2.82861E-6/(SIGMA * SIGMA) *T/P*SQRT(T/GASMOL)/OMEGA
      VMU(II)=RHO(II)*DBAR *VMU5/VMU1                                   B25A 107
      IF(KR(5)) 461,461,460                                             B25A 108
  460 RHOE(ISS)=RHO(II)                                                 B25A 109
      VMUE(ISS)=VMU (II)                                                B25A 110
      VMWE=WM                                                           B25A 111
      IS=ISV                                                            B25A 112
      RETURN                                                            B25A 113
  461 CONTINUE                                                          B25A 114
      CAPC(II)=RHO(II)/RHOE(ISS)*VMU(II)/VMUE(ISS)                      B25A 115
      VMW(II)=WM                                                        B25A 116
      VLAM=RHO(II)*DBAR/WM*VMU6/VMU1*1.9869                             B25A 117
      SC(II)=VMU5/VMU2*WM                                               B25A 118
      IF (KKR(14)-1) 4613,4612,4611                                     B25A 122
 4611 FFK2=WM/VMU2                                                      B25A 123
      VMU1=FFK2                                                         B25A 124
      VMU3=1./WM                                                        B25A 125
      CPTIL=CPG
      HTIL=HG*1.8
      DO 4614 K=1,ISM                                                   B25A 128
 4614 ZK(K)=VK(K)                                                       B25A 129
 4612 CT=0.                                                             B25A 130
      CTR=0.                                                            B25A 131
 4613 VMU12=VMU1*VMU2                                                   B25A 132
      IF(KKR(20)) 9004,9005,9004                                        B25A 133
 9004 WRITE(KOUT,9006)OMEGA,DBAR,    VLAM,SC(II),PR(II),VMU1,VMU2,VMU3,TB25A 134
     1T(II),VMU5,VMU6,FF(1),FF(2),FF(3),CPTIL,HTIL,(VK (I),WTM(I),ZK(I),B25A 135
     2I=1,ISM),VMU(II)                                                  B25A 136
 9005 CONTINUE                                                          B25A 137
      IF(KR(6)) 5000,5340,5340                                          B25A 139
 5000 CPBAR(II)=CPG
      PR(II)=CPG/VMU6*VMU5/1.9869*WM
      NPR=ISP2
      DO 501 I=1,NPR
      DO 501 J=1,ISV2
  501 PA(I,J)=0.                                                        B25A 142
      PA(3,1)=PMU2*CPTIL*T                                              B25A 143
      DO 502 K=3,ISP2
      IF (KKR(14)-1) 5016,5016,5017                                     B25A 145
 5016 FFK2=FF(K-2)                                                      B25A 146
 5017 IF(IFC(K-2)) 502,5011,5012                                        B25A 147
 5011 PA(1,K)=VN(K-2)/FFK2                                              B25A 148
      GO TO 5013                                                        B25A 149
 5012 IF(IFC(K-2)-3) 5015,5014,5015
 5014 PA(1,K)=1./FFK2
      GO TO 5013
 5015 PA(1,K)=0.
 5013 PA(2,K)=PA(1,K)*WTM(K-2)                                          B25A 154
      PA(3,K)=PA(1,K)*H(K-2)                                            B25A 155
      IF(K-ISP)5018,5018,5019
```

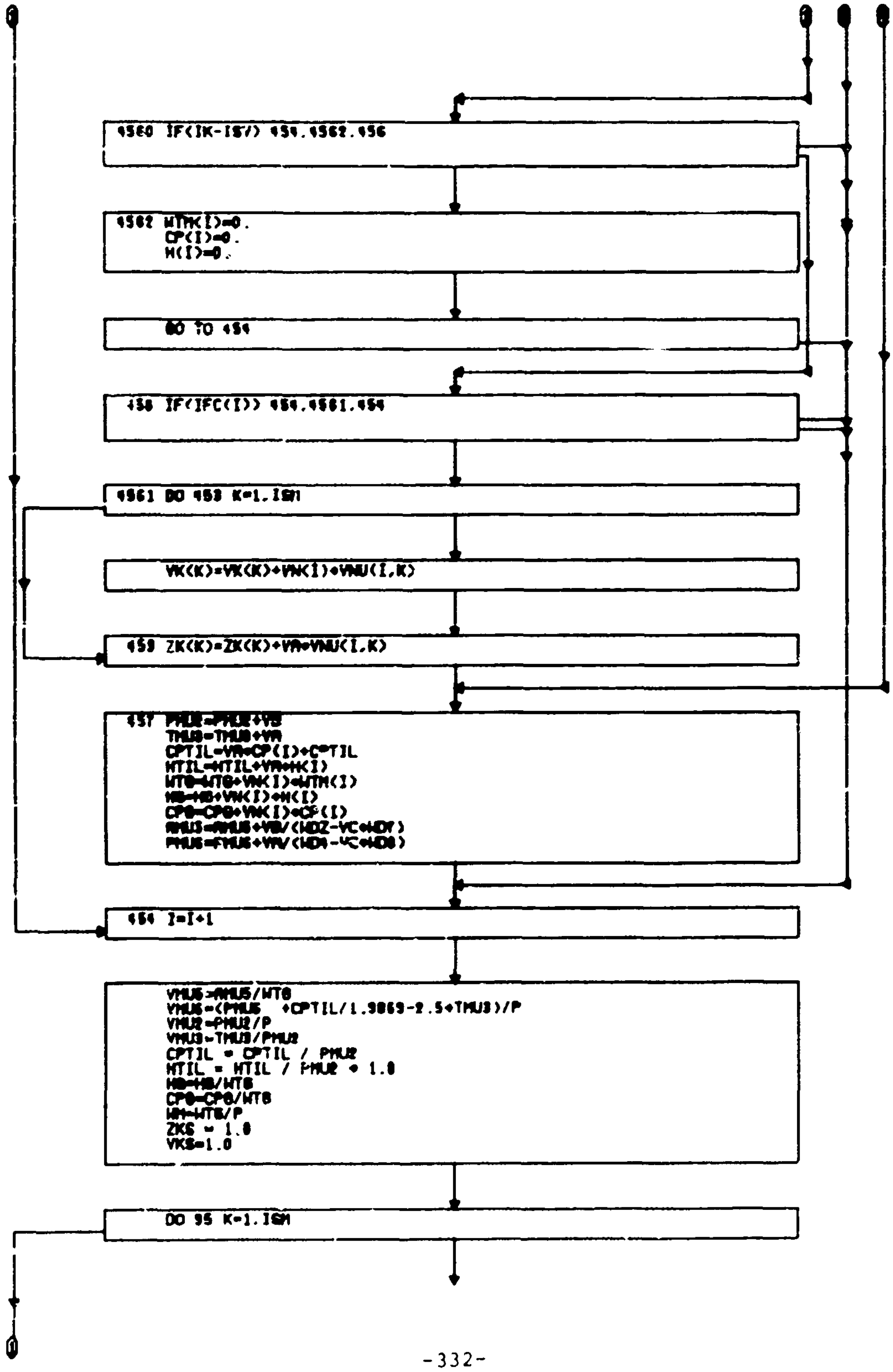
```
 5018 PA(K+1,K)=PA(1,K)
 5019 CONTINUE
  502 CONTINUE                                                      825A 157
      J=ISVP
      IF(ISVP.GT.N) GO TO 5070
      DO 507 IJ=ISVP,N
      IF(IFC(J)) 507,5021,507                                       825A 159
 5021 PRP(1)=VN(J)/FFK2
      IF (KKR(14)-1) 5022,5022,5023                                 823A 161
 5022 PRP(1)=VN(J)/FF(J)
 5023 PRP(2)=PRP(1)*WTM(J)
      PRP(3)=PRP(1)*H(J)
      DO 5024 I=4,ISP2
 5024 PRP(I)=PRP(1)*VNU(J,I-3)
      DO 505 I=1,NPR
      PA(I,1)=PA(I,1)-TC(J)*PRP(I)
      DO 505 K=1,ISV
      IF(IFC(K)) 506,506,505
  506 PA(I,K+2)=PA(I,K+2)+PRP(I)*VNU(J,K)
  505 CONTINJE
  507 J=J+1
 5070 VA=AA/WTM(IS)
      DO 511 I=1,ISV2
      A(I,1)=A(I,1)*AA/1.8                                          825A 182
  511 A(I,ISP2)=A(I,ISP2)*VA                                        825A 183
      DO 512 J=3,ISP                                                825A 184
      VA=AA/WTM(J-2)                                                825A 185
      DO 512 I=1,ISV2
  512 A(I,J)=A(I,J)*VA-A(I,ISP2)                                    825A 187
C     FORM PA,A PRODUCT AND TRANSPOSE (TO ESTABLISH EQUI  LENCE     825A 188
      DO 521 I=1,NPR
      DO 521 J=1,ISP                                                825A 190
      PV(J,I)=PA(I,1)*A(1,J)                                        825A 191
      DO 521 L=3,ISV2
  521 PV(J,I)=PV(J,I)+PA(I,L)*A(L,J)                                825A 193
      DO 533 K=1,ISP                                                825A 194
      PV(K,1)=(PV(K,1)-VMU3*PV(K,2))/PMU2                           825A 195
      PV(K,3)=(PV(K,3)*1.8-HTIL*PV(K,2))/PMU2                       825A 196
      DO 531 J=1,ISM                                                825A 197
  531 PV(K,J+3)=(PV(K,J+3)*WTM(J)-ZK(J)*PV(K,2))/PMU2               825A 198
  533 PV(K,2)=CT*A(1,K)+PV(K,2)/PMU2                                825A 199
      PV(2,2)=PV(2,2)-1./P                                          825A 200
C     POOR MAN-S EQUIVALENCE                                        825A 201
      QR(II)=0.                                                     825A 202
      DCAPCH=CAPC(II)*(2.*A(2,1)-0.341*A(1,1))                      825A 203
      DPRH=0.                                                       825A 204
      DQCH=0.                                                       825A 205
      DQRH=0.                                                       825A 206
      DCPBH=0.                                                      825A 207
      DCPTH=0.                                                      825A 208
      DMU12H=0.                                                     825A 209
      DRHOH=RHO(II)*(A(2,1)-A(1,1))                                 825A 210
      DTH=T*A(1,1)*1.8                                              823A 211
      DMU3H=PV(1,1)                                                 825A 212
      DMU4H=PV(1,2)                                                 825A 213
      DHTILH=PV(1,3)                                                825A 214
      IF (NSPM1)5340,5340,5320
 5320 DO 534 K=1,ISM
      PHIK(II,K)=0.                                                 825A 216
      DPHIKH(K)=0.                                                  825A 217
```

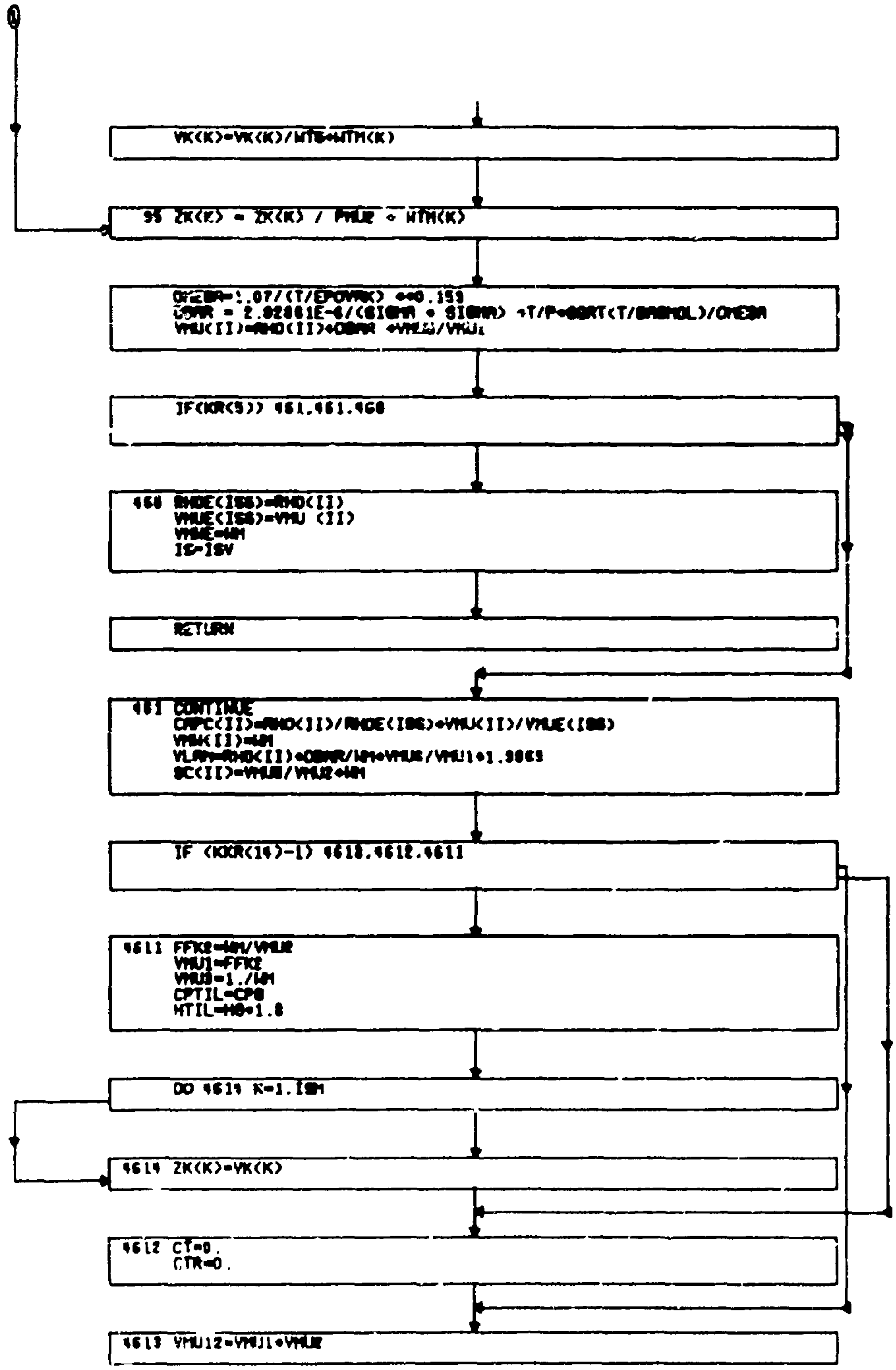
```
      DRHOK(K)=RHO(II)*(A(2,K+2)-A(1,K+2))                               B25A 218
      DPRK(K)=0.                                                         B25A 219
      DSCK(K)=0.                                                         B25A 220
      DTK(K)=T*A(1,K+2)*1.8                                              B25A 221
      DCAPCK(K)=CAPC(II)*(2.*A(2,K+2)-0.341*A(1,K+2))                    B25A 222
      DGHK(K)=0.                                                         B25A 223
      DCPBK(K)=0.                                                        B25A 224
      DCPTK(K)=0.                                                        B25A 225
      DMU12K(K)=0.                                                       B25A 226
      DMU3K(K)=PV(K+2,1)                                                 B25A 227
      DMU4K(K)=PV(K+2,2)                                                 B25A 228
      DHTILK(K)=PV(K+2,3)                                                B25A 229
      DZKH(K)=PV(1,K+3)                                                  B25A 230
      DO 532 I=1,ISM                                                     B25A 231
      DPHIKK(I,K)=0.                                                     B25A 232
  532 DZKK(I,K)=PV(K+2,I+3)                                              B25A 233
  534 CONTINUE                                                           B25A 234
 5340 LIM=N+KR(8)
      DO 535 I=1,LIM
      IF(KR(6)) 5343,5344,5344
 5343 IF(MOD(IFC(I),3)) 535,5344,535
 5344 FR(I,II)=VN(I)/P
      IF(VN(I)) 5341,5341,535                                            B25A 237
 5341 IF(IFC(I)) 535,5342,535                                            B25A 238
 5342 FR(I,II)=1.E-30                                                    B25A 239
  535 CONTINUE                                                           B25A 240
      IF(KR(6)) 538,538,5350
 5350 IF (KR(1)-1) 536,5361,5360
 5361 Y(JC)=0.
  536 HW(ISS,ITT)=HG*1.8
 5360 DO 537 K=2,IS
  537 SPW(K-1,ISS,ITT)=VK(K-1)                                           B25A 244
      RHOVW(ISS,ITT)=-RV
      IF(KR(8).GT.0) W(3)=W(3)-VN(N+1)/WTG
      WS=-W(1)-W(2)-W(3)+1.E-30
  538 CONTINUE                                                           B25A 246
      IF(KKP(20)) 9001,9002,9001                                         B25A 247
 9001 WRITE(KOUT,9006)DMU3H,DMU3K,DMU4H,DMU4K,DHTILH,DHTILK,DTH,DYK,DRHOB25A 248
     1H,DRHOK,DZKH,DZKK,HG,VK
 9002 CONTINUE                                                           B25A 250
      IS=ISV                                                             B25A 251
 9006 FORMAT(/(1X1P10E12.5))
      ISP=ISVP
      ISP2=IS+2
      IF(II-1) 551,539,551
  539 DO 540 I=1,IS
  540 YW(I)=Y(I)
  551 RETURN
      END                                                                B25A 253
```

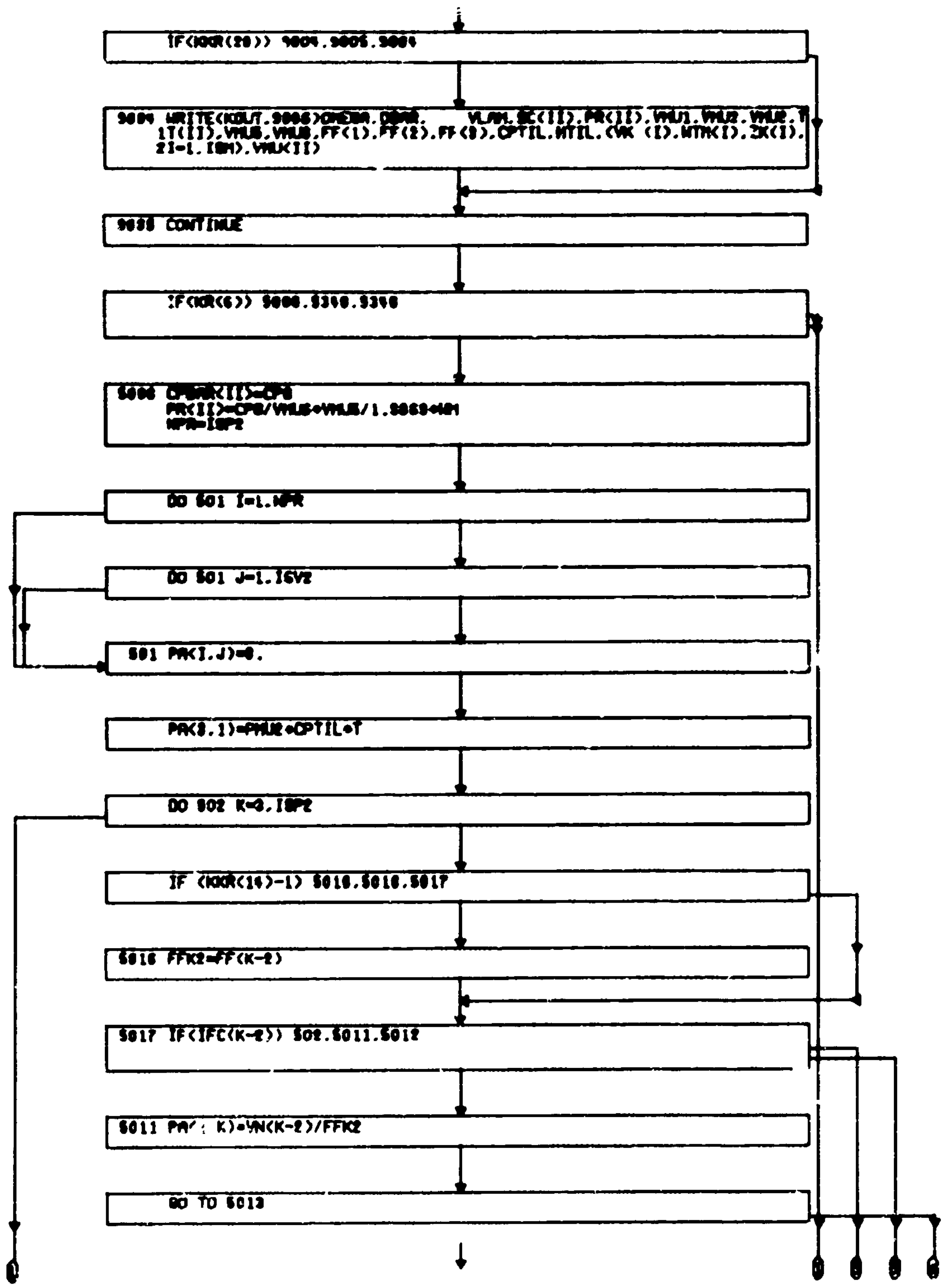
c. Flow Chart

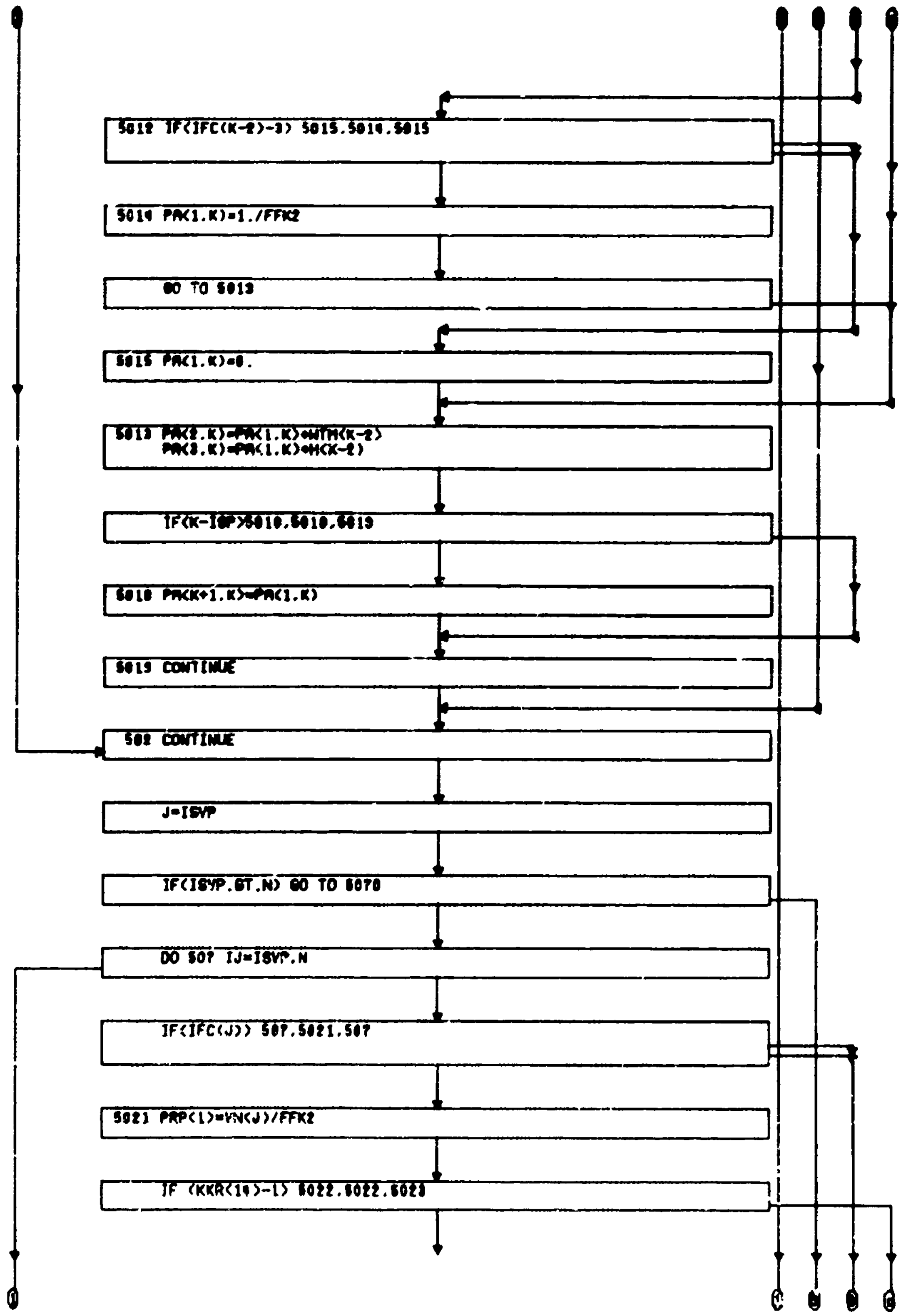

SUBROUTINE PROPS
IF(II-1) 310,300,310
300 IF(KKR(14)-10) 310,302,302
302 KKR(14)=KKR(14)-10
310 IF(T-300.001) 312,312,320
312 KKR(14)=KKR(14)+10
320 WM=AM/P
ISV=IS
IS=NSP
ISVP=ISV+1
643 ISV2=ISV+2
CT=-0.5
ISM=IS-1
ISP=IS+1
ISP2=IS+2
TT(II)=T*1.8
RHO(II)=AM/(1.3146*T)
CTR=CT*1.9876
C FORM NECESSARY SUMMATIONS
PMUR=0.
CPTIL=0.
WTB=0.
HB=0.
CPB=0.
HTIL=0.
PMU1=0.
THUS=0.
I=1
DO 451 IK=1,N
IF(ISV-IS) 544,544,541
541 IF(IK-ISV) 544,451,542
542 H(I)=H(I)-VNU(I,ISV)*H(ISV)

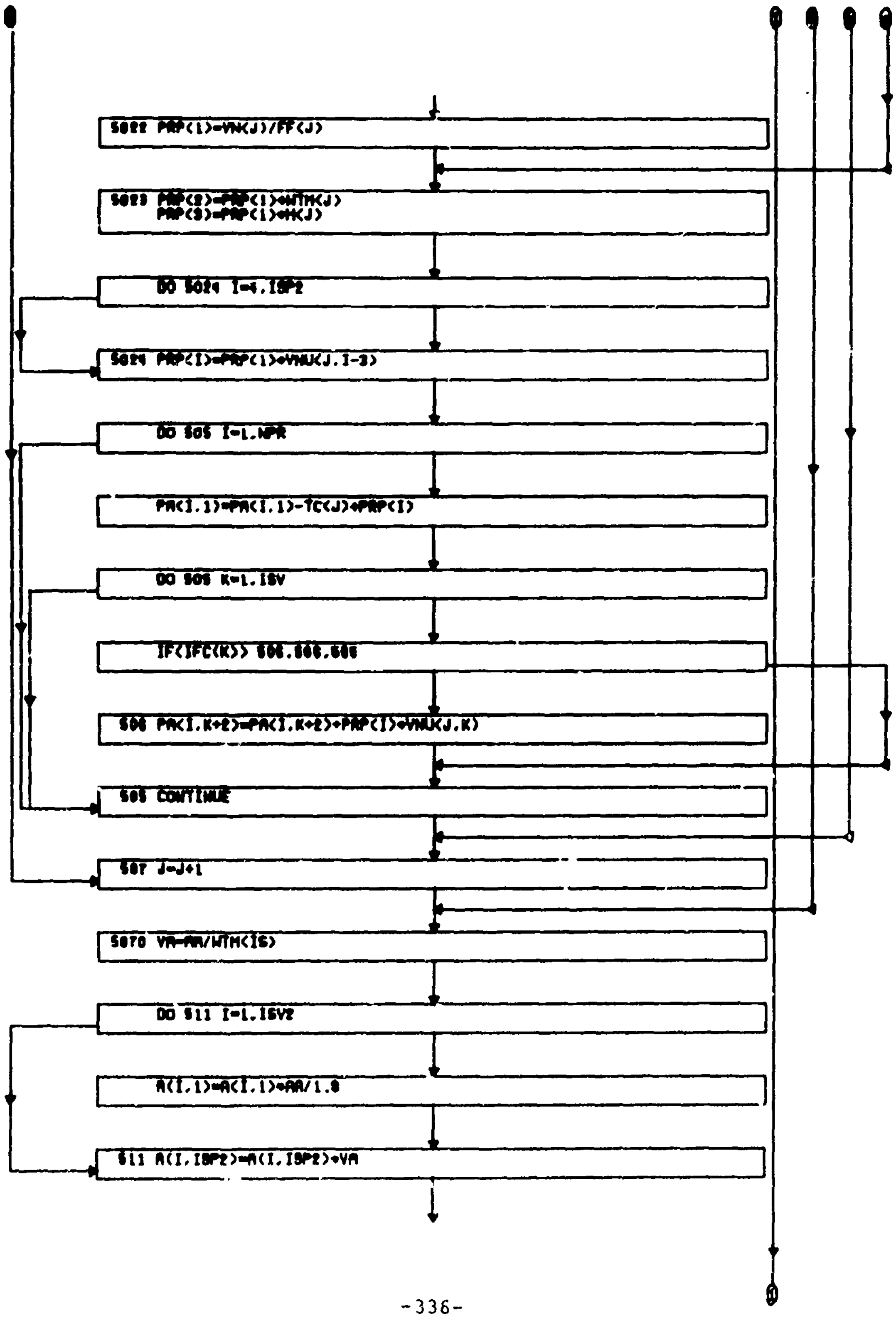

WTM(I)=WTM(I)-VNU(I ISV)+WTM(ISV)
CP(I)=CP(I)-VNU(I,ISV)*CP(ISV)
544 IF(IFC(I)) 451,4550,451
4550 PMU1=PMU1+VN(I)*FF(I)
451 I=I+1
VMU1=PMU1/P
AMU5=0.
PMU6=0.
WDZ=1.385
WD4 = 0.284*WDZ
I = 1
DO 454 IK = 1,N
ASTAR = 1.13 * GG(I)/FF(I) * GB(I)/FF(I)
WD2=1.2*ASTAR/PMU1
WD7=WDZ/PMU1-WD2
WD5=.22*ASTAR/PMU1
WD9=WD4/PMU1-WD5
VA=VN(I)/FF(I)
VB=VA*WTM(I)
VC=VN(I)*FF(I)
IF(IK-IS) 4510,4510,4560
4510 VK(I)=0.
ZK(I)=0
IF(IFC(I)) 454,4511,454
4511 VK(I)=VN(I)
452 ZK(I)=VA
GO TO 457

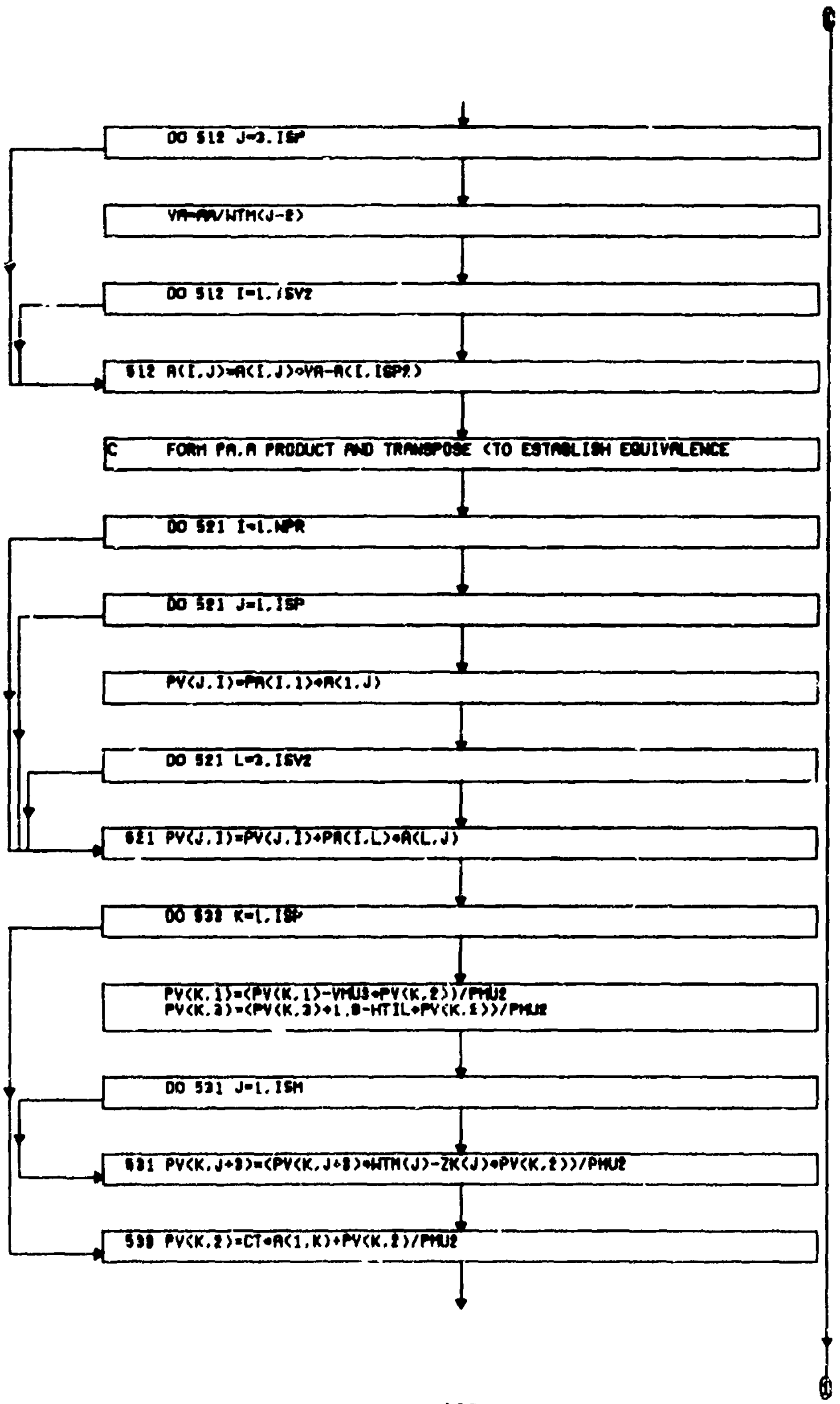

4560 IF(IK-IS7) 454,4562,456
4562 WTM(I)=0.
CP(I)=0.
H(I)=0.
GO TO 454
456 IF(IFC(I)) 454,4561,454
4561 DO 459 K=1,ISM
VK(K)=VK(K)+VN(I)*VNU(I,K)
459 ZK(K)=ZK(K)+VR*VNU(I,K)
457 PMU2=PMU2+VR
THU3=THU3+VR
CPTIL=VR*CP(I)+CPTIL
HTIL=HTIL+VR*H(I)
WTG=WTG+VN(I)*WTM(I)
HG=HG+VN(I)*H(I)
CPG=CPG+VN(I)*CP(I)
AMU5=AMU5+VR/(HDZ-VC*HDY)
PMU5=PMU5+VR/(HD4-VC*HD8)
454 I=I+1
VMU5=AMU5/WTG
VMU6=(PMU5 +CPTIL/1.9869-2.5*THU3)/P
VMU2=PMU2/P
VMU3=THU3/PMU2
CPTIL = CPTIL / PMU2
HTIL = HTIL / PMU2 * 1.0
HG=HG/WTG
CPG=CPG/WTG
WM=WTG/P
ZKS = 1.0
VKS=1.0
DO 95 K=1,ISM

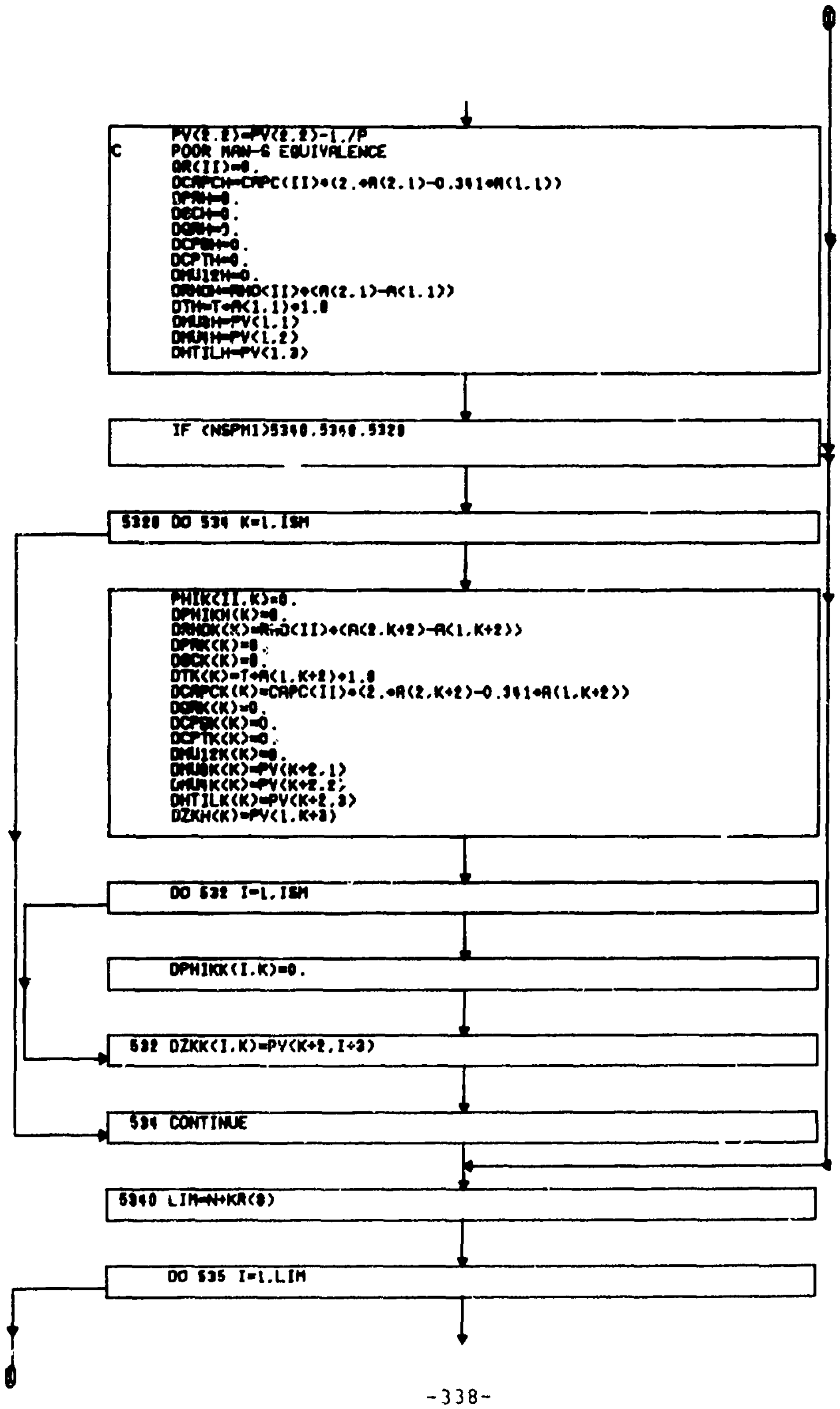

VK(K)=VK(K)/WTB*WTM(K)
95 ZK(K) = ZK(K) / PMU2 * WTM(K)
IF(KR(5)) 461,461,460
460
RETURN
461 CONTINUE
IF (KKR(14)-1) 4613,4612,4611
4611
DO 4614 K=1,ISM
4614 ZK(K)=VK(K)
4612 CT=0.
CTR=0.
4613

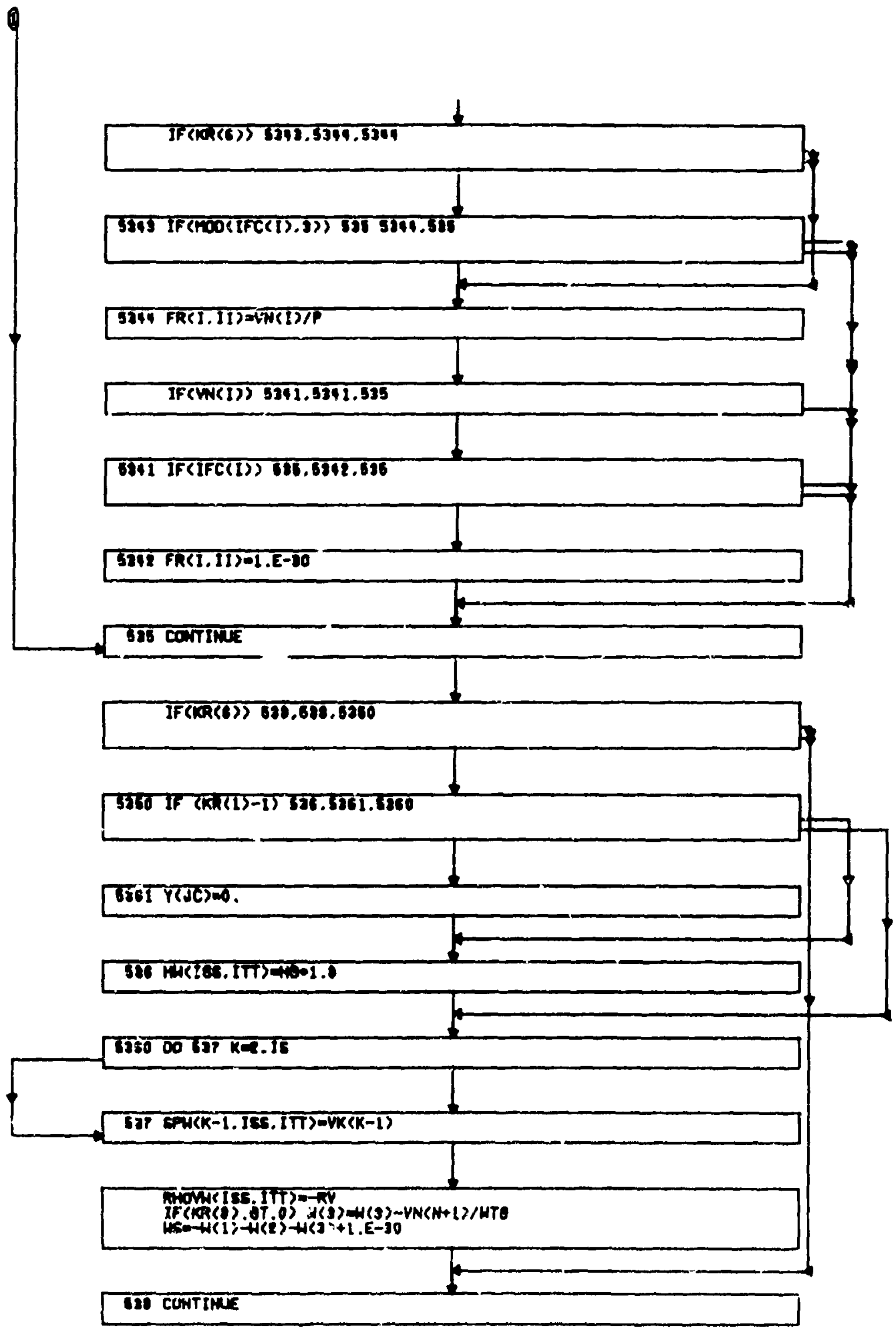

IF(KKR(20)) 9004,9005,9004
9004 WRITE(KOUT,9006)OMEGA,DBAR, VLAM,SC(II),PR(II),VNU1,VNU2,VNU2,T
1T(II),VNU5,VNU8,FF(1),FF(2),FF(3),CPTIL,WTIL,(VK (I),WTM(I),ZK(I),
2I=1,ISM),VNU(II)
9005 CONTINUE
IF(KKR(6)) 5000,5340,5340
5000 CPBAR(II)=CPS
PR(II)=CPS/VNU5*VNU5/1.9869*WM
NPR=ISP2
DO 501 I=1,NPR
DO 501 J=1,IGV2
501 PR(I,J)=0.
PR(3,1)=PNU2*CPTIL*T
DO 502 K=3,ISP2
IF (KKR(14)-1) 5010,5010,5017
5010 FFK2=FF(K-2)
5017 IF(IFC(K-2)) 502,5011,5012
5011 PA(I,K)=YN(K-2)/FFK2
GO TO 5013

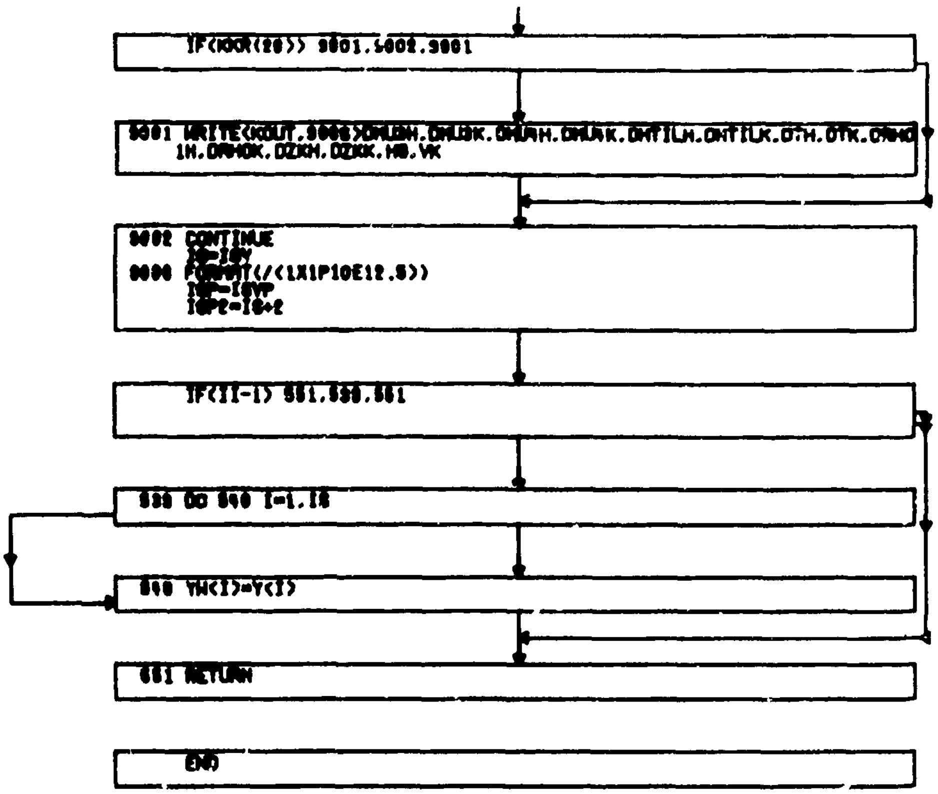

5012 IF(IFC(K-2)-3) 5015.5014.5015
5014 PR(1.K)=1./FFK2
GO TO 5013
5015 PR(1.K)=0.
5013 PR(2.K)=PR(1.K)*WTM(K-2)
PR(3.K)=PR(1.K)*H(K-2)
IF(K-ISP)5010.5010.5019
5010 PR(K+1.K)=PR(1.K)
5019 CONTINUE
502 CONTINUE
J=ISVP
IF(ISVP.GT.N) GO TO 5070
DO 507 IJ=ISVP.N
IF(IFC(J)) 507.5021.507
5021 PRP(1)=VN(J)/FFK2
IF (KKR(14)-1) 5022.5022.5023


5022 PRP(1)=VN(J)/FF(J)
5023 PRP(2)=PRP(1)*WTM(J)
PRP(3)=PRP(1)*H(J)
DO 5024 I=4.ISP2
5024 PRP(I)=PRP(1)*VNU(J.I-3)
DO 505 I=1.NPR
PA(I.1)=PA(I.1)-TC(J)*PRP(I)
DO 505 K=1.ISV
IF(IFC(K)) 506.506.506
506 PA(I.K+2)=PA(I.K+2)+PRP(I)*VNU(J.K)
505 CONTINUE
507 J=J+1
5070 VA=AA/WTM(IS)
DO 511 I=1.ISV2
A(I.1)=A(I.1)+AA/1.8
511 A(I.ISP2)=A(I.ISP2)+VA


C
DO 512 J=3.ISP
VA=AA/WTM(J-2)
DO 512 I=1.ISV2
512 A(I.J)=A(I.J)*VA-A(I.ISP2)
C FORM PA.A PRODUCT AND TRANSPOSE (TO ESTABLISH EQUIVALENCE
DO 521 I=1.NPR
DO 521 J=1.ISP
PV(J.I)=PA(I.1)*A(1.J)
DO 521 L=2.ISV2
521 PV(J.I)=PV(J.I)+PA(I.L)*A(L.J)
DO 532 K=1.ISP
PV(K.1)=(PV(K.1)-VMU3*PV(K.2))/PMU2
PV(K.3)=(PV(K.3)+1.0-HTIL*PV(K.2))/PMU2
DO 531 J=1.ISM
531 PV(K.J+3)=(PV(K.J+3)*WTM(J)-ZK(J)*PV(K.2))/PMU2
532 PV(K.2)=CT*A(1.K)+PV(K.2)/PMU2
D


PV(2.2)=PV(2.2)-1./P
C POOR MAN-S EQUIVALENCE
QR(II)=0.
DCAPCH=CAPC(II)*(2.*A(2.1)-0.341*A(1.1))
DPRH=0.
DGCH=0.
DQRH=0.
DCPGH=0.
DCPTH=0.
DMU12H=0.
DRHOH=RHO(II)*(A(2.1)-A(1.1))
DTH=T*A(1.1)*1.0
DMU0H=PV(1.1)
DMUNH=PV(1.2)
DHTILH=PV(1.3)
IF (NSPM1)5340.5340.5320
5320 DO 534 K=1.ISM
PHIK(II.K)=0.
DPHIKH(K)=0.
DRHOK(K)=RHO(II)*(A(2.K+2)-A(1.K+2))
DPRK(K)=0.
DGCK(K)=0.
DTK(K)=T*A(1.K+2)*1.0
DCAPCK(K)=CAPC(II)*(2.*A(2.K+2)-0.341*A(1.K+2))
DQRK(K)=0.
DCPGK(K)=0.
DCPTK(K)=0.
DMU12K(K)=0.
DMU0K(K)=PV(K+2.1)
DMUNK(K)=PV(K+2.2)
DHTILK(K)=PV(K+2.3)
DZKH(K)=PV(1.K+3)
DO 532 I=1.ISM
DPHIKK(I.K)=0.
532 DZKK(I.K)=PV(K+2.I+3)
534 CONTINUE
5340 LIM=N+KR(0)
DO 535 I=1.LIM


1
IF(KR(6)) 5343,5344,5344
5343 IF(MOD(IFC(I),3)) 535 5344,535
5344 FR(I,II)=VN(I)/P
IF(VN(I)) 5341,5341,535
5341 IF(IFC(I)) 535,5342,535
5342 FR(I,II)=1.E-30
535 CONTINUE
IF(KR(8)) 538,538,5350
5350 IF (KR(1)-1) 536,5361,5360
5361 Y(JC)=0.
536 HW(ISS,ITT)=HS*1.0
5360 DO 537 K=2,IS
537 SPW(K-1,ISS,ITT)=VK(K-1)
RHOVW(ISS,ITT)=-RV
IF(KR(8).GT.0) W(3)=W(3)-VN(N+1)/WT8
WS=-W(1)-W(2)-W(3)+1.E-30
538 CONTINUE


IF(KKR(28)) 9001.9002.9001
9001 WRITE(KOUT.9006)DMUDH.DMUDK.DMUAH.DMUAK.DHTILH.DHTILK.DTH.DTK.DRHO
1H.DRHOK.DZKH.DZKK.HB.VK
9002 CONTINUE
IS=ISV
9006 FORMAT(/(1X1P10E12.5))
ISP=ISVP
ISP2=IS+2
IF(II-1) 551.530.551
530 DO 540 I=1.IS
540 YH(I)=Y(I)
551 RETURN
END

27. SUBROUTINE TAYLOR (D,FM,F,P) - B26A

a. Function

Calculates coefficients in Taylor series expansions of integrals which appear in the integral form of the boundary layer equations. Called by HISTXI, IMONE.

D = Distance between neighboring nodes I and I-1

FM = Value of function and its derivatives at I-1

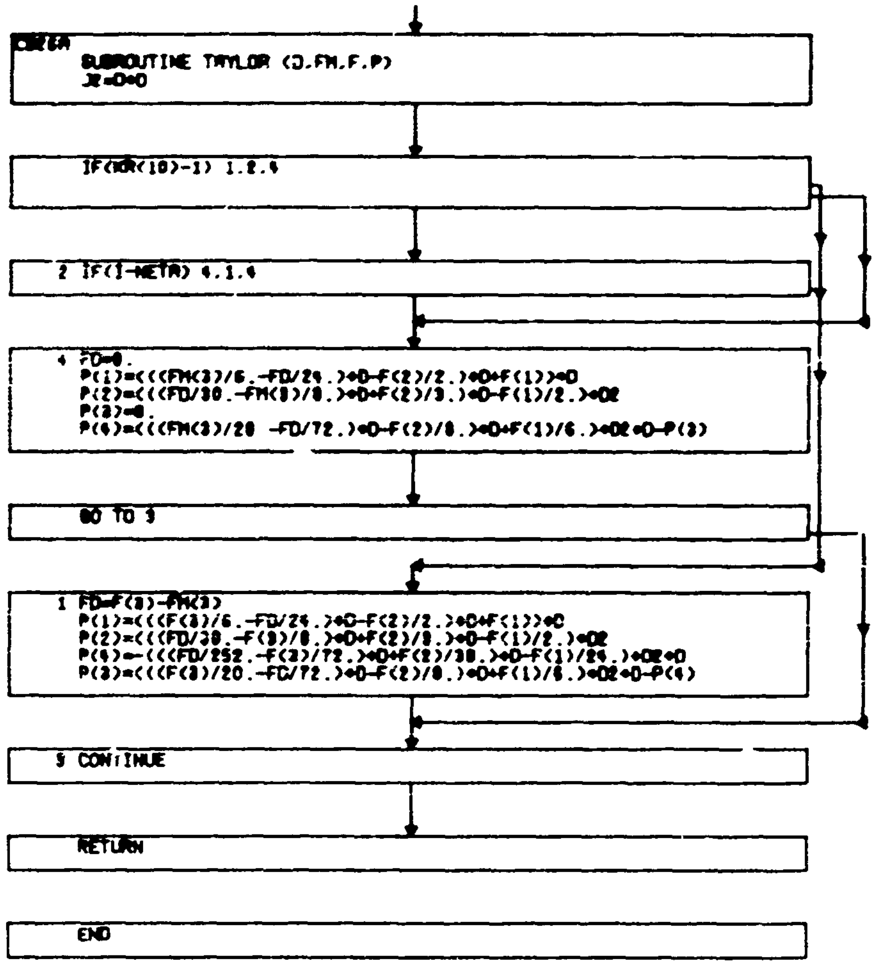
F = Value of function and its derivatives at I

P = Terms in Taylor series expansions

b. **Listing**

```
      CR264
      SUBROUTINE TAYLOR (D,FM,F,P)
      DIMENSION FM(1),F(1),P(1)
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT11,MAT21,MAT1J,MAT2J,NETA,I
      D2=D*D
      IF(KR(10)-1) 1,2,4
    2 IF(I-NETA) 4,1,4
    4 FD=0.
      P(1)=(((FM(3)/6.-FD/24.)*D-F(2)/2.)*D+F(1))*D
      P(2)=(((FD/30.-FM(3)/8.)*D+F(2)/3.)*D-F(1)/2.)*D2
      P(3)=0.
      P(4)=(((FM(3)/20.-FD/72.)*D-F(2)/6.)*D+F(1)/6.)*D2*D-P(3)
      GO TO 3
    1 FD=F(3)-FM(3)
      P(1)=(((F(3)/6.-FD/24.)*D-F(2)/2.)*D+F(1))*D
      P(2)=(((FD/30.-F(3)/8.)*D+F(2)/3.)*D-F(1)/2.)*D2
      P(4)=-(((FD/252.-F(3)/72.)*D+F(2)/30.)*D-F(1)/24.)*D2*D
      P(3)=(((F(3)/20.-FD/72.)*D-F(2)/8.)*D+F(1)/6.)*D2*D-P(4)
    3 CONTINUE
      RETURN
      END
```

c. Flow Chart


SUBROUTINE TAYLOR (D,FM,F,P)
D2=D*D
IF(KOR(10)-1) 1,2,4
2 IF(I-METR) 4,1,4
4 FD=0.
P(1)=(((FM(3)/6.-FD/24.)*D-F(2)/2.)*D+F(1))*D
P(2)=(((FD/30.-FM(3)/8.)*D+F(2)/3.)*D-F(1)/2.)*D2
P(3)=0.
P(4)=(((FM(3)/20 -FD/72.)*D-F(2)/8.)*D+F(1)/6.)*D2*D-P(3)
GO TO 5
1 FD=F(3)-FM(3)
P(1)=(((F(3)/6.-FD/24.)*D-F(2)/2.)*D+F(1))*D
P(2)=(((FD/30.-F(3)/8.)*D+F(2)/3.)*D-F(1)/2.)*D2
P(4)=-(((FD/252.-F(3)/72.)*D+F(2)/30.)*D-F(1)/24.)*D2*D
P(3)=(((F(3)/20.-FD/72.)*D-F(2)/8.)*D+F(1)/6.)*D2*D-P(4)
5 CONTINUE
RETURN
END

28. SUBROUTINE LINMAT

a. Function

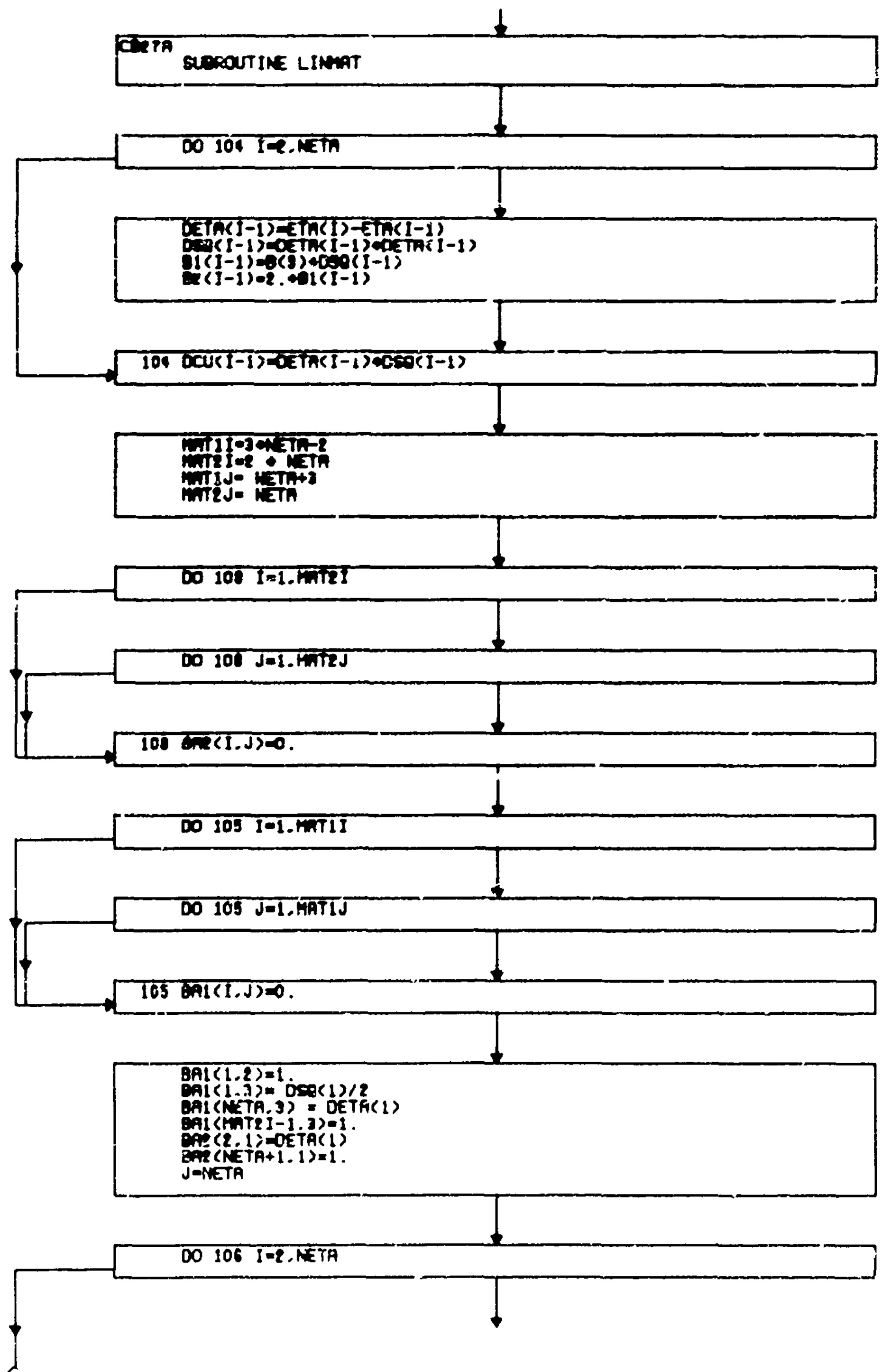
Sets up matrices for Taylor series expansions and linear boundary conditions from eta spacing, and solves to express linear corrections in terms of nonlinear corrections. Called by SETUP. Calls MATS1, MATS2.

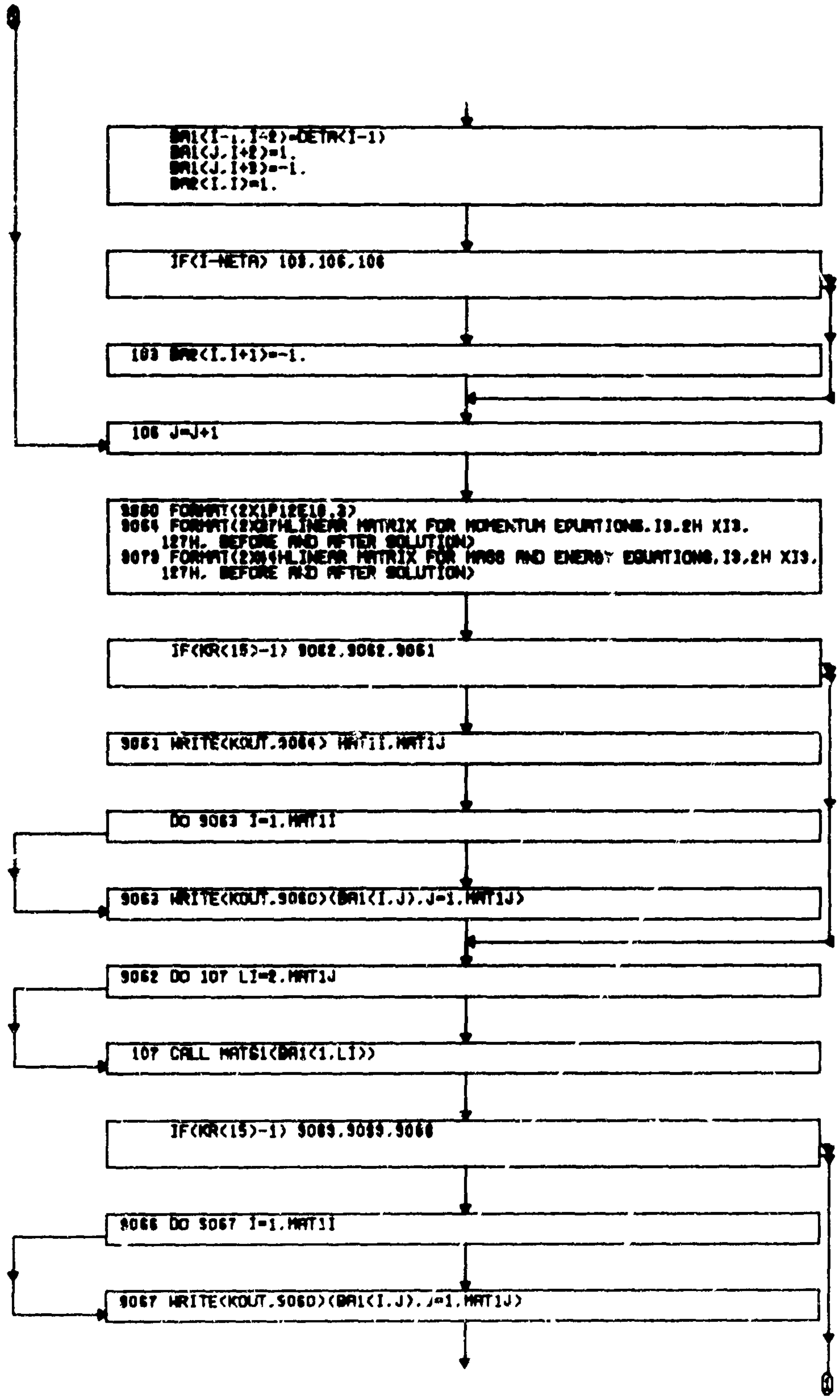
b. Listing

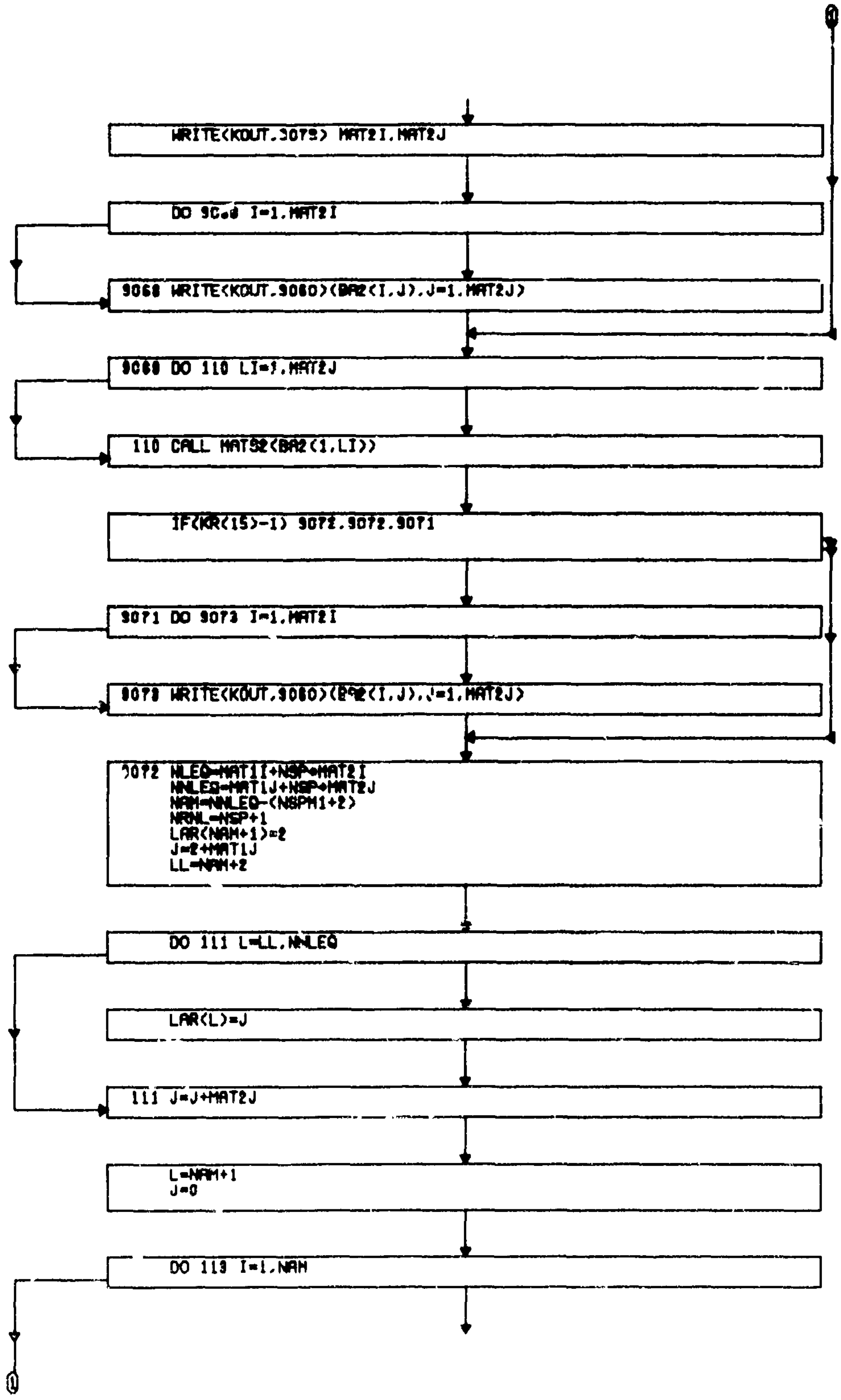
```
      C-27A                                                             B27A 001
            SUBROUTINE LINMAT                                           B27A 002
            COMMON/ETACOM/ETA(15),DETA(15),DSQ(14),DCU(14),B1(14),B2(14) B27A   3ONE
           1,BA2(15),BA1(43,18),BA2(30,15)                             B27A   4ONE
            COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NB27A   5ONE
           1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B27A   6ONE
           2,R( ),     NNE. N,K (12),ITEM, ITEM,KR17,NBT,NBT2,IDENT,KR9(40) B27A   7ONE
           3,KAUX),UTIME,JSPEC,MD(3)                                  B27A   8ONE
            DO 104 I=2,NETA                                             B27A 008**-6
            DETA(I-1)=ETA(I)-ETA(I-1)                                   B27A 009
            DSQ(I-1)=DETA(I-1)*DETA(I-1)                                B27A 010
            B1(I-1 =-(3.*DSQ(I-1)                                       B27A 011
            B2(I-1)=2.*B1(I-1)                                          B27A 012
        104 DCU(I-1)=DETA(I-1)*DSQ(I-1)                                 B27A 013
            MAT1I=3*NETA-2                                              B27A 014
            MAT2I=2 * NETA
            MAT1J= NETA+3
            MAT2J= NETA
            DO 108 I=1,MAT2I
            DO 108 J=1,MAT2J
        108 BA2(I,J)=0.
            DO 105 I=1,MAT1I                                            B27A 017
            DO 105 J=1,MAT1J                                            B27A 018
        105 BA1(I,J)=0.                                                 B27A 019
            BA1(1,2)=1.                                                 B27A 020
            BA1(1,3)= DSQ(1)/2.
            BA1(NETA,3) = DETA(1)
            BA1(MAT2I-1,3)=1.
            BA2(2,1)=DETA(1)
            BA2(NETA+1,1)=1.
            J=NETA
            DO 106 I=2,NETA                                             B27A 022
            BA1(I-1,I+2)=DETA(I-1)
            BA1(J,I+2)=1.
            BA1(J,I+3)=-1.
            BA2(I,I)=1.
            IF(I-NETA) 103,106 106
        103 BA2(I,I+1)=-1.
        106 J=J+1
       9060 FORMAT(2X1P12E10,3)                                         B27A 031
       9064 FORMAT(2X37HLINEAR MATRIX FOR MOMENTUM EQUATIONS,I3,2H XI3,  B27A 032
           127H, BEFORE AND AFTER SOLUTION)                             B27A 033
       9079 FORMAT(2X44HLINEAR MATRIX FOR MASS AND ENERGY EQUATIONS,I3,2H XI3,B27A 034
           127H, BEFORE AND AFTER SOLUTION)                             B27A 035
            IF(KR(15)-1) 9062,9062,9061                                 B27A 036
       9061 WRITE(KOUT,9064) MAT1I,MAT1J                                B27A 037
            DO 9063 I=1,MAT1I                                           B27A 038
       9063 WRITE(KOUT,9060)(BA1(I,J),J=1,MAT1J)                        B27A 039
       9062 DO 107 LI=2,MAT1J
        107 CALL MATS1(BA1(1,LI))
            IF(KR(15)-1) 9069,9069,9066                                 B27A 055
       9066 DO 9067 I=1,MAT1I                                           B27A 056
       9067 WRITE(KOUT,9060)(BA1(I,J),J=1,MAT1J)                        B27A 057
            WRITE(KOUT,9079) MAT2I,MAT2J                                B27A 058
            DO 9068 I=1,MAT2I                                           B27A 059
       9068 WRITE(KOUT,9060)(BA2(I,J),J=1,MAT2J)                        B27A 060
       9069 DO 110 LI=1,MAT2J
        110 CALL MATS2(BA2(1,LI))
```

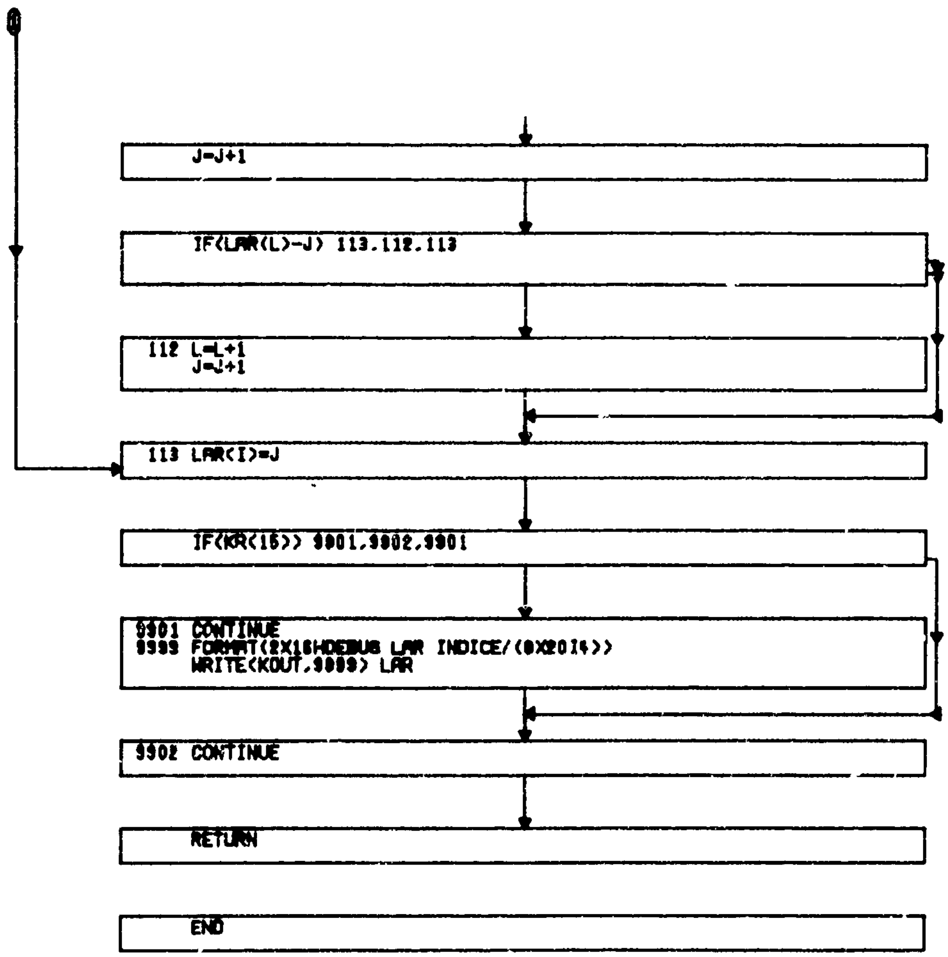
```
      IF(KR(15)-1) 9072,9072,9071                               827A 063
 9071 DO 9073 I=1,MAT2I                                         827A 064
 9073 WRITE(KOUT,9060)(BA2(I,J),J=1,MAT2J)                      827A 065
 9072 NLEQ=MAT1I+NSP*MAT2I                                      827A 066
      NNLEQ=MAT1J+NSP*MAT2J                                     827A 067
      NAM=NNLEQ-(NSPM1+2)                                       827A 068
      NRNL=NSP+1                                                827A 069
      LAR(NAM+1)=2
      J=2+MAT1J
      LL=NAM+2
      DO 111 L=LL,NNLEQ
      LAR(L)=J
  111 J=J+MAT2J
      L=NAM+1
      J=0
      DO 113 I=1,NAM
      J=J+1
      IF(LAR(L)-J) 113,112,113
  112 L=L+1
      J=J+1
  113 LAR(I)=J
      IF(KR(15)) 9901,9902,9901                                 827A 085
 9901 CONTINUE                                                  827A 086
 9999 FORMAT(2X16HDEBUG LAR INDICE/(8X20I4))                    827A 087
      WRITE(KOUT,9999) LAR                                      827A 088
 9902 CONTINUE                                                  827A 089
      RETURN                                                    827A 090
      END                                                       827A 091
```

c. Flow Chart


CBETA
SUBROUTINE LINMAT
DO 104 I=2,NETA
DETA(I-1)=ETA(I)-ETA(I-1)
DSQ(I-1)=DETA(I-1)*DETA(I-1)
B1(I-1)=B(3)*DSQ(I-1)
B2(I-1)=2.*B1(I-1)
104 DCU(I-1)=DETA(I-1)*DSQ(I-1)
MAT1I=3*NETA-2
MAT2I=2 * NETA
MAT1J= NETA+3
MAT2J= NETA
DO 108 I=1,MAT2I
DO 108 J=1,MAT2J
108 BA2(I,J)=0.
DO 105 I=1,MAT1I
DO 105 J=1,MAT1J
105 BA1(I,J)=0.
BA1(1,2)=1.
BA1(1,3)= DSQ(1)/2
BA1(NETA,3) = DETA(1)
BA1(MAT2I-1,3)=1.
BA2(2,1)=DETA(1)
BA2(NETA+1,1)=1.
J=NETA
DO 106 I=2,NETA
U


BA1(I-1.I+2)=DETA(I-1)
BA1(J.I+2)=1.
BA1(J.I+3)=-1.
BA2(I.I)=1.
IF(I-NETA) 103.106.106
103 BA2(I.I+1)=-1.
106 J=J+1
9080 FORMAT(2X1P12E10.3)
9064 FORMAT(2X37HLINEAR MATRIX FOR MOMENTUM EQUATIONS.I3.2H XI3.
127H. BEFORE AND AFTER SOLUTION)
9079 FORMAT(2X44HLINEAR MATRIX FOR MASS AND ENERGY EQUATIONS.I3.2H XI3.
127H. BEFORE AND AFTER SOLUTION)
IF(KR(15)-1) 9062.9062.9061
9061 WRITE(KOUT.9064) MAT1I.MAT1J
DO 9063 I=1.MAT1I
9063 WRITE(KOUT.9080)(BA1(I.J).J=1.MAT1J)
9062 DO 107 LI=2.MAT1J
107 CALL MATS1(BA1(1.LI))
IF(KR(15)-1) 9089.9089.9066
9066 DO 9067 I=1.MAT1I
9067 WRITE(KOUT.9080)(BA1(I.J).J=1.MAT1J)


1
WRITE(KOUT,3075) MAT2I,MAT2J
DO 9068 I=1,MAT2I
9068 WRITE(KOUT,9080)(BA2(I,J),J=1,MAT2J)
9069 DO 110 LI=1,MAT2J
110 CALL MATS2(BA2(1,LI))
IF(KR(15)-1) 9072,9072,9071
9071 DO 9073 I=1,MAT2I
9073 WRITE(KOUT,9080)(BA2(I,J),J=1,MAT2J)
9072 NLEQ=MAT1I+NSP+MAT2I
NNLEQ=MAT1J+NSP+MAT2J
NAM=NNLEQ-(NSPM1+2)
NANL=NSP+1
LAR(NAM+1)=2
J=2+MAT1J
LL=NAM+2
DO 111 L=LL,NNLEQ
LAR(L)=J
111 J=J+MAT2J
L=NAM+1
J=0
DO 113 I=1,NAM
1


B
J=J+1
IF(LAR(L)-J) 113,112,113
112 L=L+1
J=J+1
113 LAR(I)=J
IF(KR(15)) 9901,9902,9901
9901 CONTINUE
9999 FORMAT(2X16HDEBUG LAR INDICE/(8X20I4))
WRITE(KOUT,9999) LAR
9902 CONTINUE
RETURN
END

29. SUBROUTINE KINET - B28A

a. Function

Determines rates for kinetically-controlled reactions, ascertains the controlling reactions on the basis of which it forms transformation matrix, prepares the reduced correction coefficients for the kinetic terms, and combines them with the previously determined coefficients. Called by MATER.

b. Listing

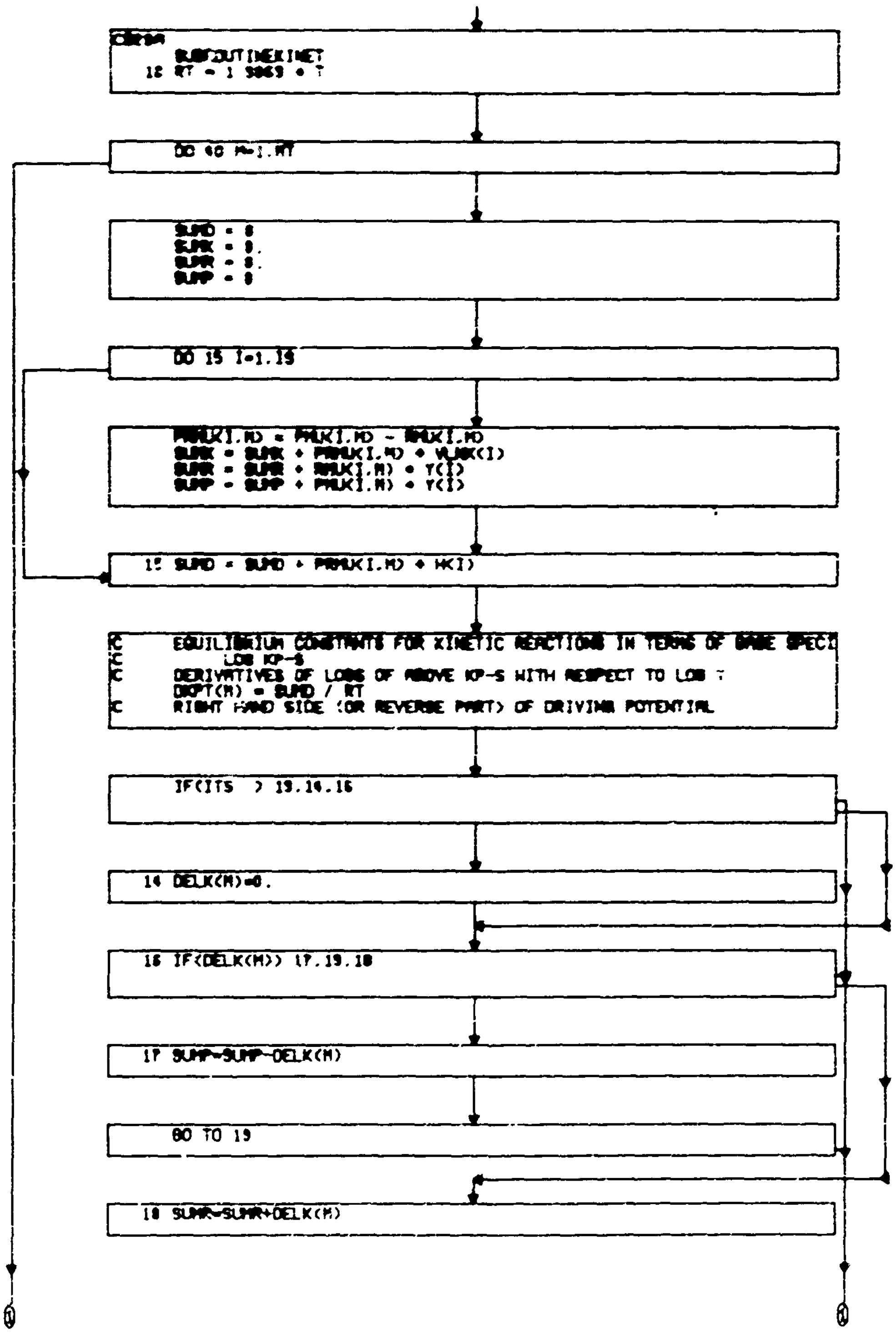
```
      CB28A
              SUBROUTINEKINET                                             KINE0010
              COMMON /MISCOM/ C1,C2,C3
              COMMON /BUMCOM/ BUMP,CORMA,EASE
              COMMON/INTCOM/KKR(20),KIN,KOUT
              DIMENSION ELKM(10),DELK(10)                                 B28A 004*NEW
              COMMON /EQPCOM/ RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),B28A    5*NEW
             1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),  B28A    6*NEW
             2 KAT(10),IR(10),IS,KR(10),LAMI( 71),P,T,TK(10, 7),VN( 71),        B28A    7*NEW
             3 VNU( 71,10),ITFF,KR2,HCH,NCV,WM,WTM( 71),Y( 71),YW( 71),GG( 71)  B28A    8*NEW
             4 ,TQ(10, 7),EPOVRK,SIGMA,BASMOL                                   B28A    9*NEW
              COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,   B28A   10*NEW
             1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPG,   B28A   11*NEW
             2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,SP,RV,IFCJC,WTG,WTL,JC,HG,  B28A   12*NEW
             3 CPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),B(16),      B28A   13*NEW
             4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,  B28A   14*NEW
             5 CP( 71),H( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUB(10),        B28A   15*NEW
             6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JJ( 4)                     B28A   16*NEW
              COMMON/KINCOM/MT,FKF(10),EAK(10),EXK(10),PMU(10,10),RMU(10,10),   B28A   17*NEW
             1 DKPT(10),PKP(10),FKR(10),RAT(10),RSIG(10),MA(10),LL(10),PMR(10), B28A   18*NEW
             2 PRMU(10,10),EESE(10)                                             B28A   19*NEW
            5 FORMAT(13I3)                                                KINE0320*-16
           10 RT = 1.9869 * T                                             KINE0330
              DO 40 M=1,MT                                                KINE0340
              SUMD = 0.                                                   KINE0350
              SUMK = 0.                                                   KINE0360
              SUMR = 0.                                                   KINE0370
              SUMP = 0.                                                   KINE0380
              DO 15 I=1,IS                                                KINE0390
              PRMU(I,M) = PMU(I,M) - RMU(I,M)                             KINE0400
              SUMK = SUMK + PRMU(I,M) * VLNK(I)                           KINE0410
              SUMR = SUMR + RMU(I,M) * Y(I)                               KINE0420
              SUMP = SUMP + PMU(I,M) * Y(I)                               KINE0430
           15 SUMD = SUMD + PRMU(I,M) * H(I)                              KINE0440
      C       EQUILIBRIUM CONSTANTS FOR KINETIC REACTIONS IN TERMS OF BASE SPECIKINE0450
      C            LOG KP-S                                               KINE0460
      C       DERIVATIVES OF LOGS OF ABOVE KP-S WITH RESPECT TO LOG T     KINE0480
              DKPT(M) = SUMD / RT                                         KINE0490
      C       RIGHT HAND SIDE (OR REVERSE PART) OF DRIVING POTENTIAL      KINE0500
              IF(ITS  ) 19,14,16
           14 DELK(M)=0.
           16 IF(DELK(M)) 17,19,18
           17 SUMP=SUMP-DELK(M)
              GO TO 19
           18 SUMR=SUMR+DELK(M)
           19 ELKM(M)=SUMP-SUMK-SUMR
              PKP(M) = EXP(SUMP - SUMK)                                   KINE0510
      C       LEFT HAND SIDE (OR FORWARD PART) OF DRIVING POTENTIAL       KINE0520
              PKR(M) = EXP(SUMR)                                          KINE0530
              VK1 = PKR(M) - PKP(M)                                       KINE0540
              IF (VK1) 25,20,25                                           KINE0550
           20 VK1 = 1.E - 9 * PKR(M)                                      KINE0560
           25 CONTINUE
              VK2 = AA * FKF(M) * (ABS(VK1)) * * (EXK(M) - 1.) * EXP( - EAK(M) /KINE0580
             1 RT)*(-C3)
              VK3 = VK2                                                   KINE0600
              IF (EXK(M) - 1.) 35,30,30                                   KINE0610
           30 VK3 = VK2 * EXK(M)                                          KINE0620
```

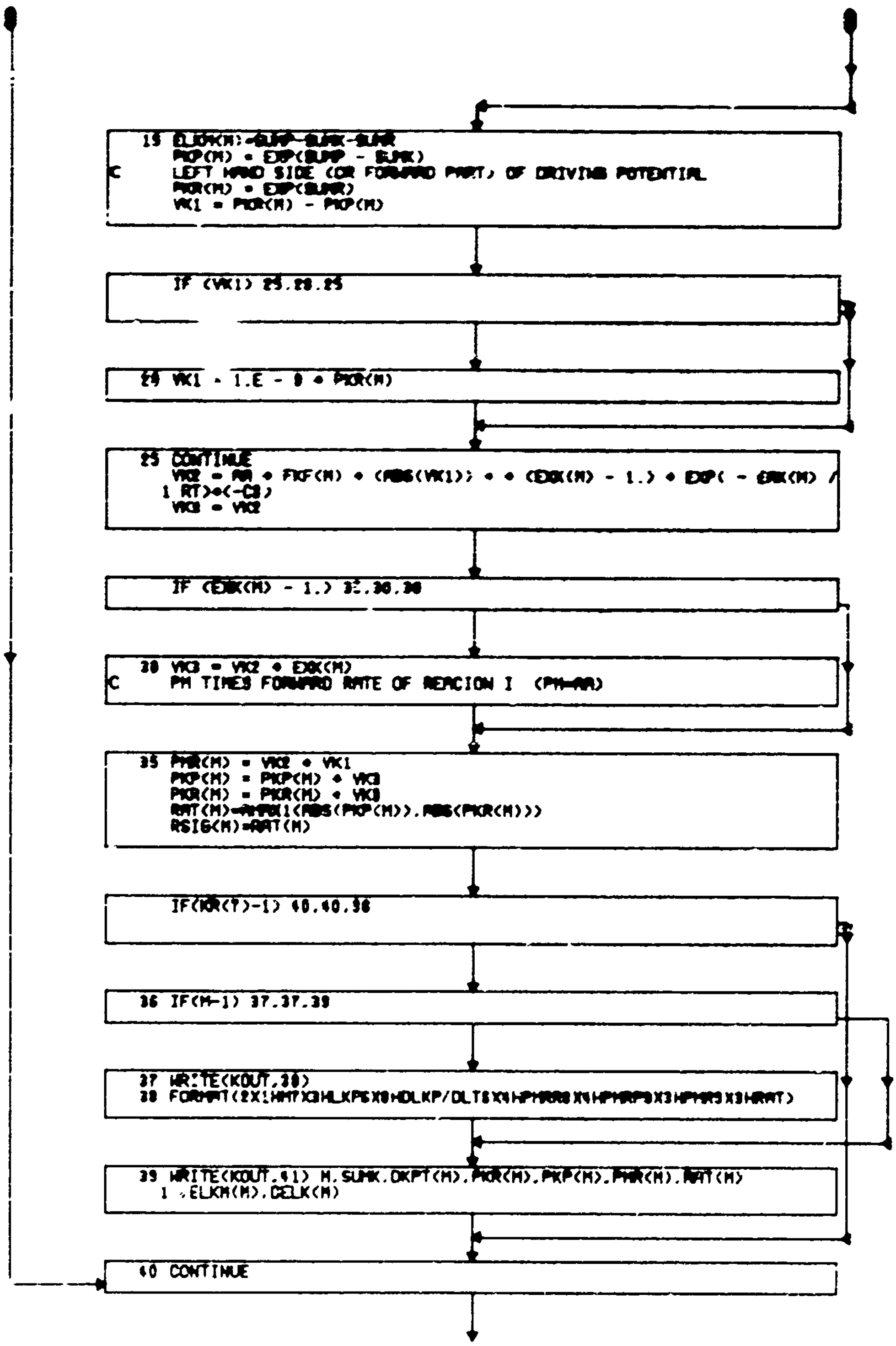
```
C       PM TIMES FORWARD RATE OF REACION ,  (PM*AA)                     KINE0630
     35 PMR(M) = VK2 * VK1                                              KINE0640
        PKP(M) = PKP(M) * VK3                                           KINE0650
        PKR(M) = PKR(M) * VK3                                           KINE0660
        RAT(M)=AMAX1(ABS(PKP(M)),ABS(PKR(M)))
        RSIG(M)=RAT(M)
        IF(KR(7)-1) 40,40,36
     36 IF(M-1) 37,37,39
     37 WRITE(KOUT,38)
     38 FORMAT(2X1HM7X3HLKP6X8HDLKP/DLT6X4HPMRR8X4HPMRP9X3HPMR9X3HRAT)
     39 WRITE(KOUT,41) M,SUMK,DKPT(M),PKR(M),PKP(M),PMR(M),RAT(M)
      1 ,ELKM(M),DELK(M)
     40 CONTINUE
     41 FORMAT(I3,2X8E12.5)
     45 FORMAT(1X29HA(I,J),B(I),I=1,8,J=1,8 IN)                         KINE0690
     50 FORMAT(1X12E10.3)                                               KINE0700
     55 FORMAT(1X27HA(I,J),B(I),I=1,8,J=1,8 OUT)                        KINE0710
        IF (KR(7) - 1) 80,80,65                                         KINE0730
     65 CONTINUE
        WRITE(KOUT,50)PRMU                                              KINE0810
        WRITE(KOUT,215)                                                 KINE0820
        WRITE(KOUT,50)(EB(I),I=1,IS)                                    KINE0830
        WRITE(KOUT,50)(E(I),I=1,IS)
     70 WRITE(KOUT,45)                                                  KINE0840
        DO 75 I=1,ISP2                                                  KINE0850
     75 WRITE(KOUT,50)(A(I,J),J=1,ISPG),B(I)
     80 CONTINUE                                                        KINE0870
        IF(ITS) 105,85,105
C*****ORDER REACTIONS                                                   KINE0880
     85 DO 86 M=1,MT
     86 MA(M)=M
        IF(MT-1) 105,105,90
     90 K = 0                                                           KINE0900
        DO 100 M=2,MT                                                   KINE0910
        IF(RSIG(M)-RSIG(M-1)) 100,100,95
     95 K = MA(M)                                                       KINE0930
        MA(M) = MA(M - 1)                                               KINE0940
        MA(M - 1) = K                                                   KINE0950
        DUM1=RSIG(M)
        RSIG(M)=RSIG(M-1)
        RSIG(M-1)=DUM1
    100 CONTINUE                                                        KINE0990
        IF (K) 105,105,85                                               KINE1000
C*****START SECOND MAJOR LOOP ON REACTIONS                              KINE1010
    105 DO 200 MM=1,MT
        RSIG(MM)=0.
        M = MA(MM)                                                      KINE1030
C*****IS IT A CONTROLLING REACTION                                      KINE1040
        IF(ITS) 106,108,106
    106 L=LL(MM)
        IF(L) 126,126,107
    107 DUM=ABS(PRMU(L,M)*RAT(M))
        GO TO 130
    108 LL(MM)=0
        DO 125 L=1,IS                                                   KINE1060
        IF (PRMU(L,M)) 110,125,110                                      KINE1070
    110 DO 115 K=1,MM                                                   KINE1080
        IF (L - LL(K)) 115,125,115                                      KINE1090
    115 CONTINUE                                                        KINE1100
        DUM=ABS(PRMU(L,M)*RAT(M))
```

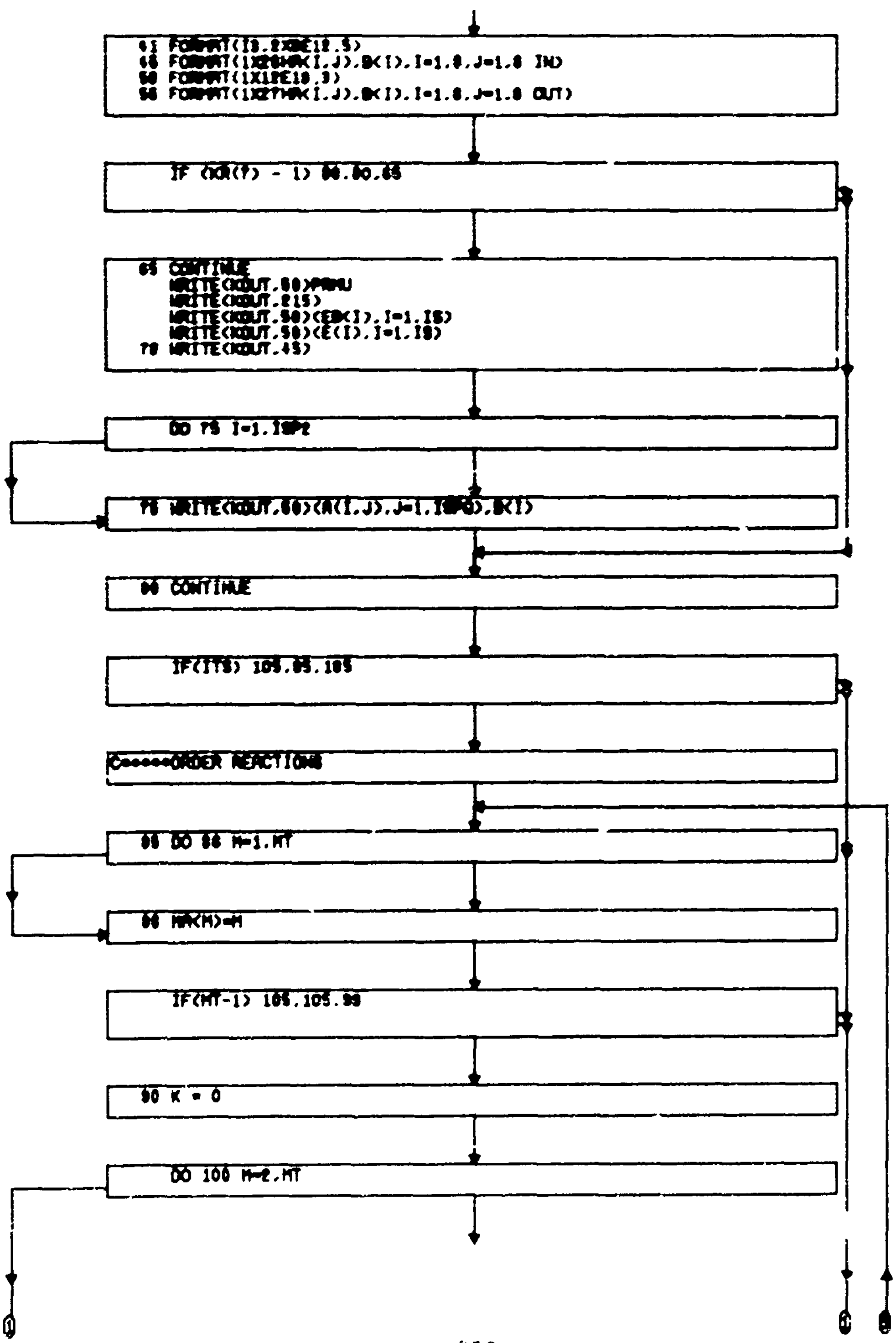
```
      IF(ABS(PRMU(L,M))-.001) 125,125,120
C* * * YES,IT IS FOR MASS BALANCE L
  120 LL(MM) = L
      GOTO 130
  125 CONTINUE
C* * *NO, IT IS NOT, ADD INTO ALL MASS BALANCES
  126 I1=1
      I2 = IS
      GOTO 170
C*****REARRANGE ACCORDING TO CONTROLLING REACTION
  130 RSIG(MM)=DUM/EB(L)*0.1
      DUM1=PRMU(L,M)
      PRMU(L,M) = 0.
      DO 165 I=1,IS
      IF (PRMU(I,M)) 135,165,135
  135 DUM2 = PRMU(I,M) / DUM1
      IP(I)=1
      MP = MM + 1
      IF (MT - MP) 155,140,140
  140 DO 150 K=MP,MT
      MI = MA(K)
      PRMU(I,MI) = PRMU(I,MI) - DUM2 * PRMU(L,MI)
      IF (ABS(PRMU(I,MI)) - .001) 145,150,150
  145 PRMU(I,MI) = 0.
  150 CONTINUE
  155 DO 160 K=1,ISP2
  160 A(I + 2,K) = A(I + 2,K) - DUM2 * A(L + 2,K)
      B(I + 2) = B(I + 2) - DUM2 * B(L + 2)
      E(I)=E(I)-DUM2*E(L)
      DUM2 = ABS(DUM2)
      EB(I) = AMAX1(EB(I) ,DUM2 * EB(L))
  165 CONTINUE
      PRMU(L,M) = DUM1
C*****ADD CONTROLLING REACTION INTO ITS MASS BALANCE
      I1 = L
      I2 = L
      EOL=E(L)+PMR(M)*PRMU(L,M)
      IF(ITS) 170,230,170
  230 DELK(M)=(1.-EABE)*ELKM(M)*AMIN1(1.,ABS(EOL/EB(L)))
      ELKM(M)=ELKM(M)-DELK(M)
      IF(PKR(M)-PKP(M)) 240,170,235
  235 PKP(M)=PKP(M)*EXP(-DELK(M))
      GO TO 245
  240 PKR(M)=PKR(M)*EXP(DELK(M))
  245 PMR(M)=PKR(M)-PKP(M)
  170 DO 176 J=1,IS
      IF(IFC(J)) 171,171,176
  171 SUMD = RMU(J,M) * PKR(M) - PMU(J,M) * PKP(M)
      DO 175 I=I1,I2
  175 A(I + 2,J + 2) = A(I + 2,J + 2) - SUMD * PRMU(I,M)
  176 CONTINUE
      SUMD = - PKP(M) * DKPT(M) - EAK(M) / RT * PMR(M)
      DO 180 I=I1,I2
      DUM1 = PMR(M) * PRMU(I,M)
      A(I+2,2)=A(I+2,2)-DUM1
      A(I + 2,1) = A(I + 2,1) + SUMD * PRMU(I,M)
      E(I)=E(I)+DUM1
      B(I + 2) = B(I + 2) + DUM1
  180 EB(I) = AMAX1(EB(I) ,ABS(PRMU(I,M) * RAT(M)))
      EB(I) =AMAX1(EB(I),ABS(E(I)))
```

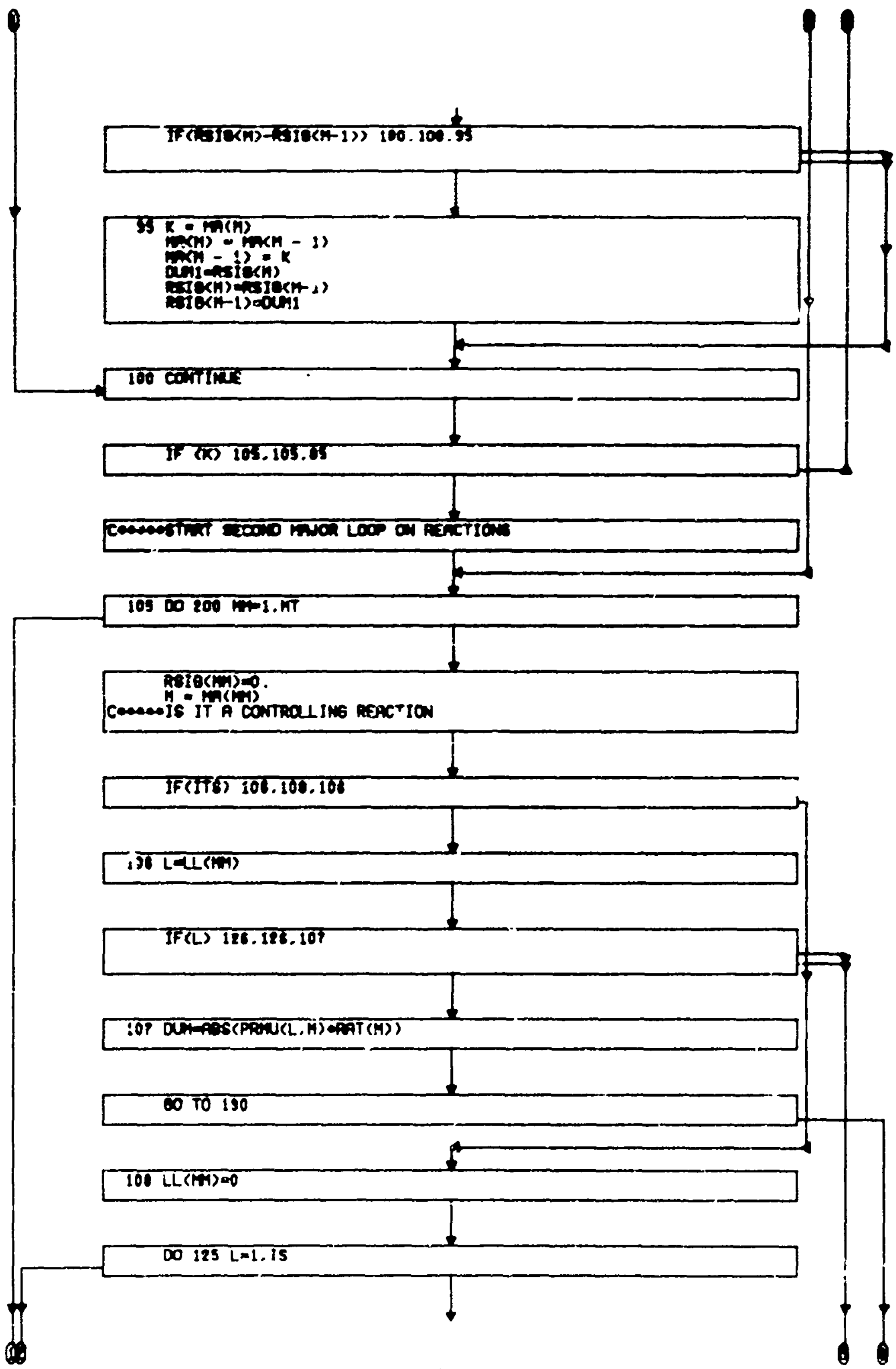
```
      IF (KPRT - 1) 200,200,185
  185 WRITE(KOUT,215)
      WRITE(KOUT,50)(EB(I),I=1,IS)
      WRITE(KOUT,50)(E(I),I=1,IS)
  190 WRITE(KOUT,55)
      DO 195 I=1,ISP2
      WRITE(KOUT,50)(A(I,J),J=1,ISP2),B(I)
  195 CONTINUE
      WRITE(KOUT,51)M,I1,I2,L,LL,MM,MA
      WRITE(KOUT,52)PRN
  200 CONTINUE
C*****MODIFY COEFFICIENTS TO ACHIEVE LINEARITY AS EQUIL IS APPROACHED
      DO 206 MM=1,MT
      L=LL(MM)
      IF(L) 201,206,201
  201 M=MA(MM)
      DUM2=RSIG(MM)
      IF(ITS) 250,240,250
  240 EESE(L)=E(L)*(1.-EASE)/(1.+DUM2)
  250 E(L)=E(L)-EESE(L)
      B(L+2)=B(L+2)-EESE(L)
      EB(L)=-EB(L)
      AR=1.
      EXEL=PKR(M)/PKP(M)
      IF(EXEL) 191,191,193
  191 EXEL=1.E-35
      IF(PKP(M)-PKR(M)) 192,193,193
  192 EXEL=1.E+35
  193 CONTINUE
      EQL=E(L)*DUM2/(DUM2+1.)
      DUM1=(1.+DUM2)/(1.+RSIG(MM))
      EB(L)=EB(L)*ABS(DUM1)
      IF(ABS(EXEL-1.)-.1) 204,204,202
  202 DUM1=EXEL/(ELKM(M)*PRMU(L,M))
      AR=(DUM1*PKR(M))/PKR(M)
      AR=AMAX1(AR,0.)
      AR=AMIN1(1.,AR)
  204 DO 205 J=1,IS
      IF(IFC(J)) 203,203,205
  203 A(L+2,J+2)=A(L+2,J+2)+ EQL*(RMU(J,M)*(1.-AR)+AR*RMU(J,M))
  205 CONTINUE
      A(L+2,1)=A(L+2,1)+EQL*(DKRT(M)*(1.-AR)+EA*(M)/RT)
      A(L+2,2)=A(L+2,2)+EQL
  206 CONTINUE
  215 FORMAT(1X12HEB(I),I=1,IS)
      IF(KR(7)-1) 225,225,220
  220 WRITE(KOUT,55)
      DO 221 I=1,ISP2
  221 WRITE(KOUT,50)(A(I,J),J=1,ISP2),B(I)
      WRITE(KOUT,50)(E(I),I=1,IS)
  225 RETURN
      END
```

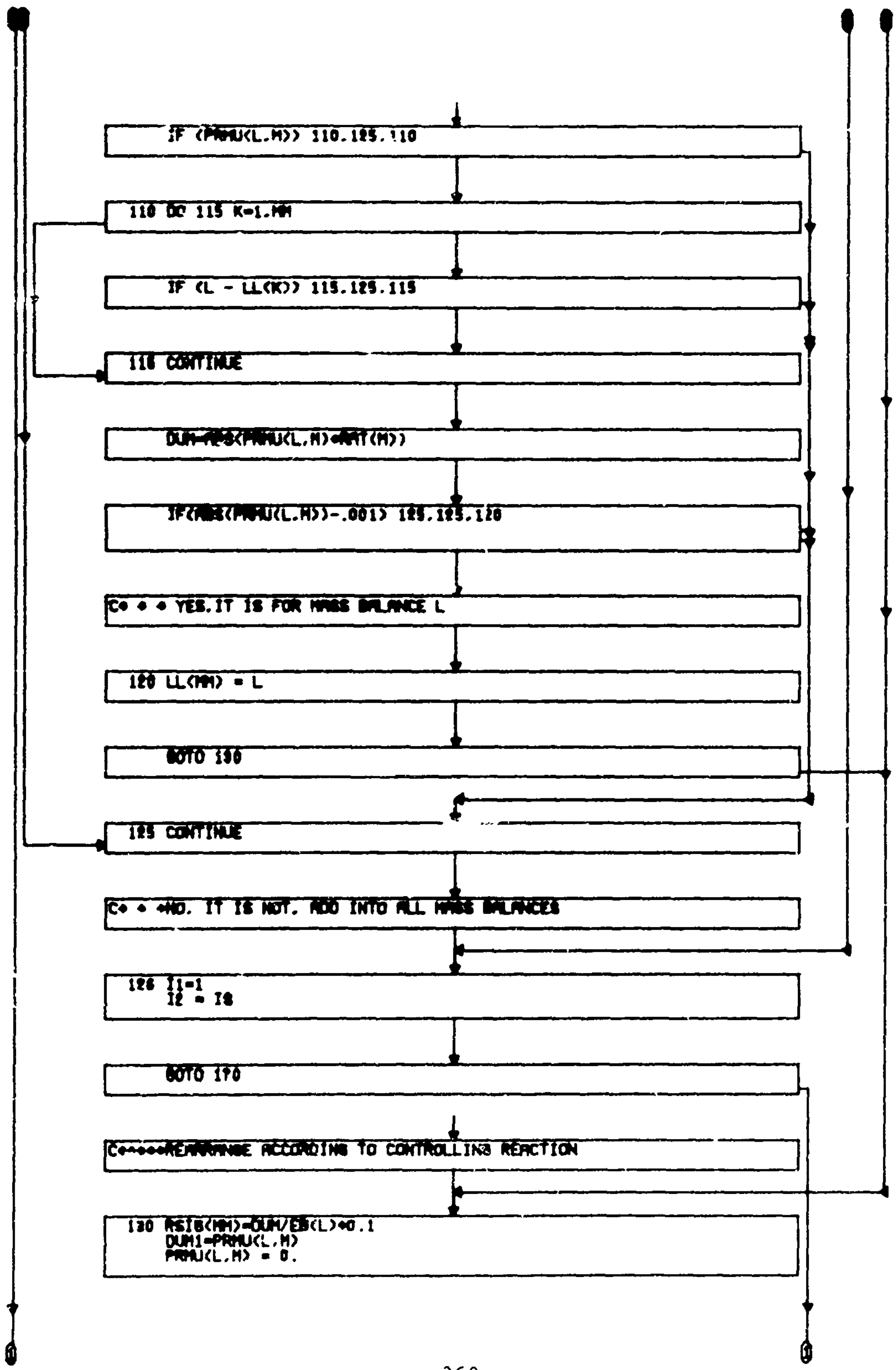
c. Flow Chart

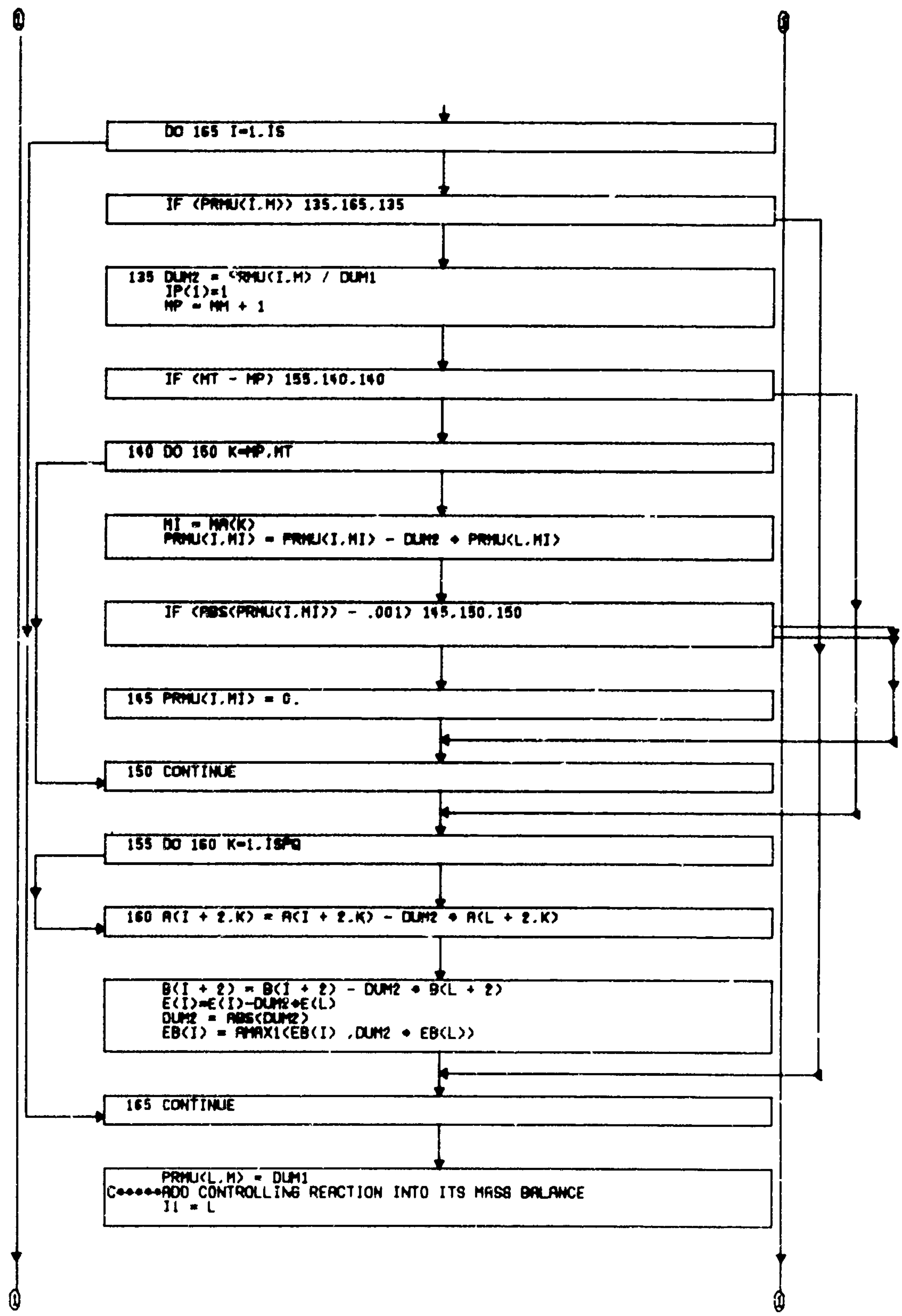

SUBROUTINEKINET
12 RT = 1.9869 * T
DO 40 M=1,NT
SUMD = 0
SUMK = 0.
SUMR = 0.
SUMP = 0
DO 15 I=1,19
PRMUK(I,M) = PMUK(I,M) - RMUK(I,M)
SUMK = SUMK + PRMUK(I,M) * VLMK(I)
SUMR = SUMR + RMUK(I,M) * Y(I)
SUMP = SUMP + PMUK(I,M) * Y(I)
15 SUMD = SUMD + PRMUK(I,M) * H(I)
C EQUILIBRIUM CONSTANTS FOR KINETIC REACTIONS IN TERMS OF BASE SPECI
C LOG KP-S
C DERIVATIVES OF LOGS OF ABOVE KP-S WITH RESPECT TO LOG T
DKPT(M) = SUMD / RT
C RIGHT HAND SIDE (OR REVERSE PART) OF DRIVING POTENTIAL
IF(ITS) 19,14,16
14 DELK(M)=0.
16 IF(DELK(M)) 17,19,18
17 SUMP=SUMP-DELK(M)
GO TO 19
18 SUMR=SUMR+DELK(M)
①
①

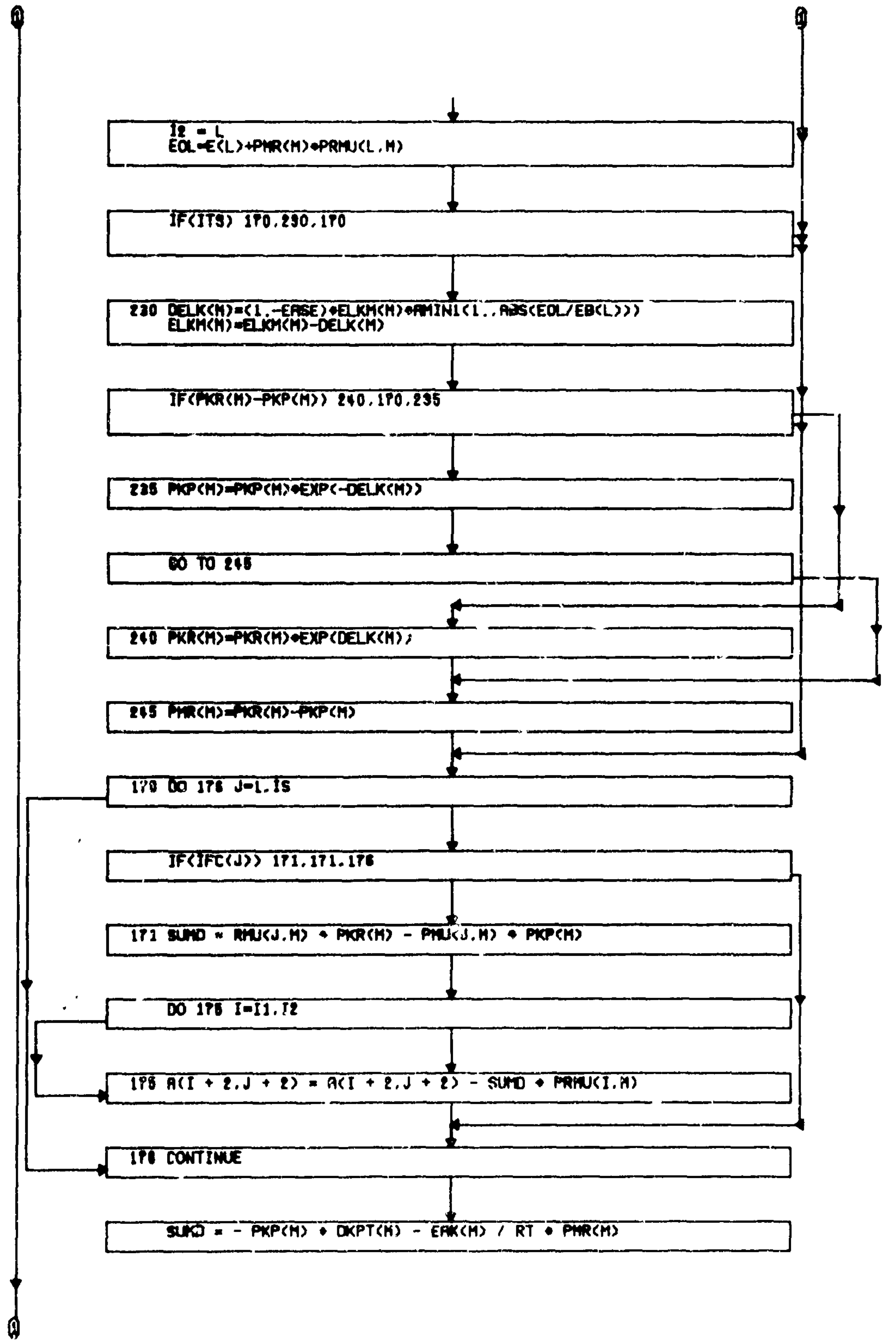

15 ELKM(M)=SUMP-SUMK-SUMR
PKP(M) = EXP(SUMP - SUMK)
C LEFT HAND SIDE (OR FORWARD PART) OF DRIVING POTENTIAL
PKR(M) = EXP(SUMR)
VK1 = PKR(M) - PKP(M)
IF (VK1) 25.20.25
20 VK1 = 1.E - 8 * PKR(M)
25 CONTINUE
VK2 = AR * FKF(M) * (ABS(VK1)) * * (EXK(M) - 1.) * EXP(- ERK(M) /
1 RT)*(-C8)
VK3 = VK2
IF (EXK(M) - 1.) 35.30.30
30 VK3 = VK2 * EXK(M)
C PM TIMES FORWARD RATE OF REACION I (PM=AR)
35 PMR(M) = VK2 * VK1
PKP(M) = PKP(M) * VK3
PKR(M) = PKR(M) * VK3
RAT(M)=AMAX1(ABS(PKP(M)).ABS(PKR(M)))
RSIG(M)=RAT(M)
IF(KR(7)-1) 40.40.36
36 IF(M-1) 37.37.39
37 WRITE(KOUT,38)
38 FORMAT(2X1HM7X3HLKP5X8HDLKP/DLT8X4HPMRR8X4HPMRP8X3HPMR3X3HRAT)
39 WRITE(KOUT.41) M.SUMK.DKPT(M).PKR(M).PKP(M).PMR(M).RAT(M)
1 ,ELKM(M).DELK(M)
40 CONTINUE


41 FORMAT(I3,2X8E12.5)
46 FORMAT(1X28HA(I,J),B(I),I=1,8,J=1,8 IN)
50 FORMAT(1X1PE10.3)
56 FORMAT(1X27HA(I,J),B(I),I=1,8,J=1,8 OUT)
IF (KR(7) - 1) 80,80,65
65 CONTINUE
WRITE(KOUT,80)PRMU
WRITE(KOUT,215)
WRITE(KOUT,50)(EB(I),I=1,IS)
WRITE(KOUT,50)(E(I),I=1,IS)
70 WRITE(KOUT,45)
DO 75 I=1,ISP2
75 WRITE(KOUT,60)(A(I,J),J=1,ISP3),B(I)
80 CONTINUE
IF(ITS) 105,85,105
C*****ORDER REACTIONS
85 DO 88 M=1,MT
88 MA(M)=M
IF(MT-1) 105,105,90
90 K = 0
DO 100 M=2,MT

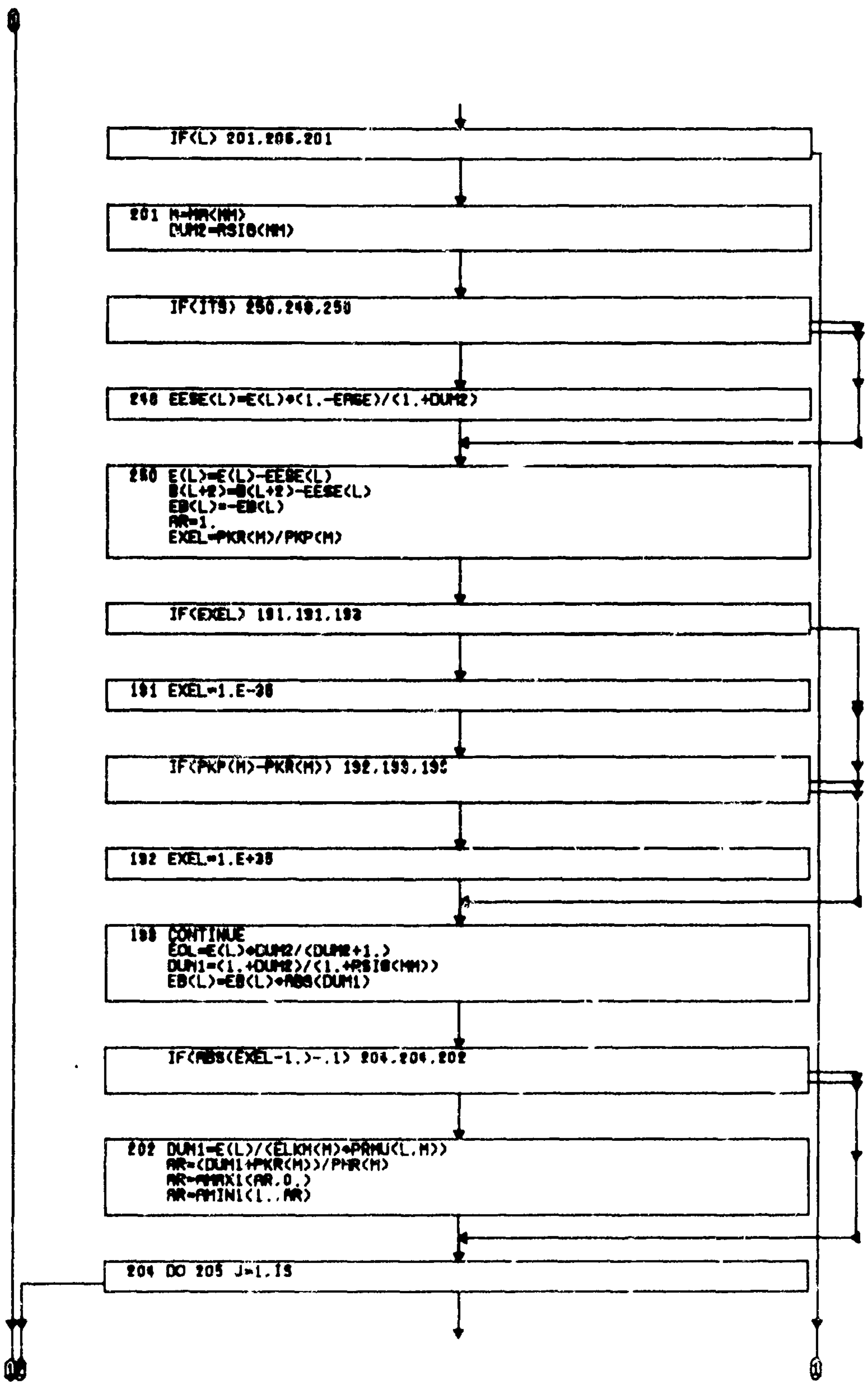

IF(RSIB(M)-RSIB(M-1)) 100.100.95
95 K = MA(M)
MA(M) = MA(M - 1)
MA(M - 1) = K
DUM1=RSIB(M)
RSIB(M)=RSIB(M-1)
RSIB(M-1)=DUM1
100 CONTINUE
IF (K) 105.105.85
C*****START SECOND MAJOR LOOP ON REACTIONS
105 DO 200 MM=1.MT
RSIB(MM)=0.
M = MA(MM)
C*****IS IT A CONTROLLING REACTION
IF(ITS) 108.108.106
106 L=LL(MM)
IF(L) 126.126.107
107 DUM=ABS(PRMU(L.M)*RAT(M))
GO TO 130
108 LL(MM)=0
DO 125 L=1.IS

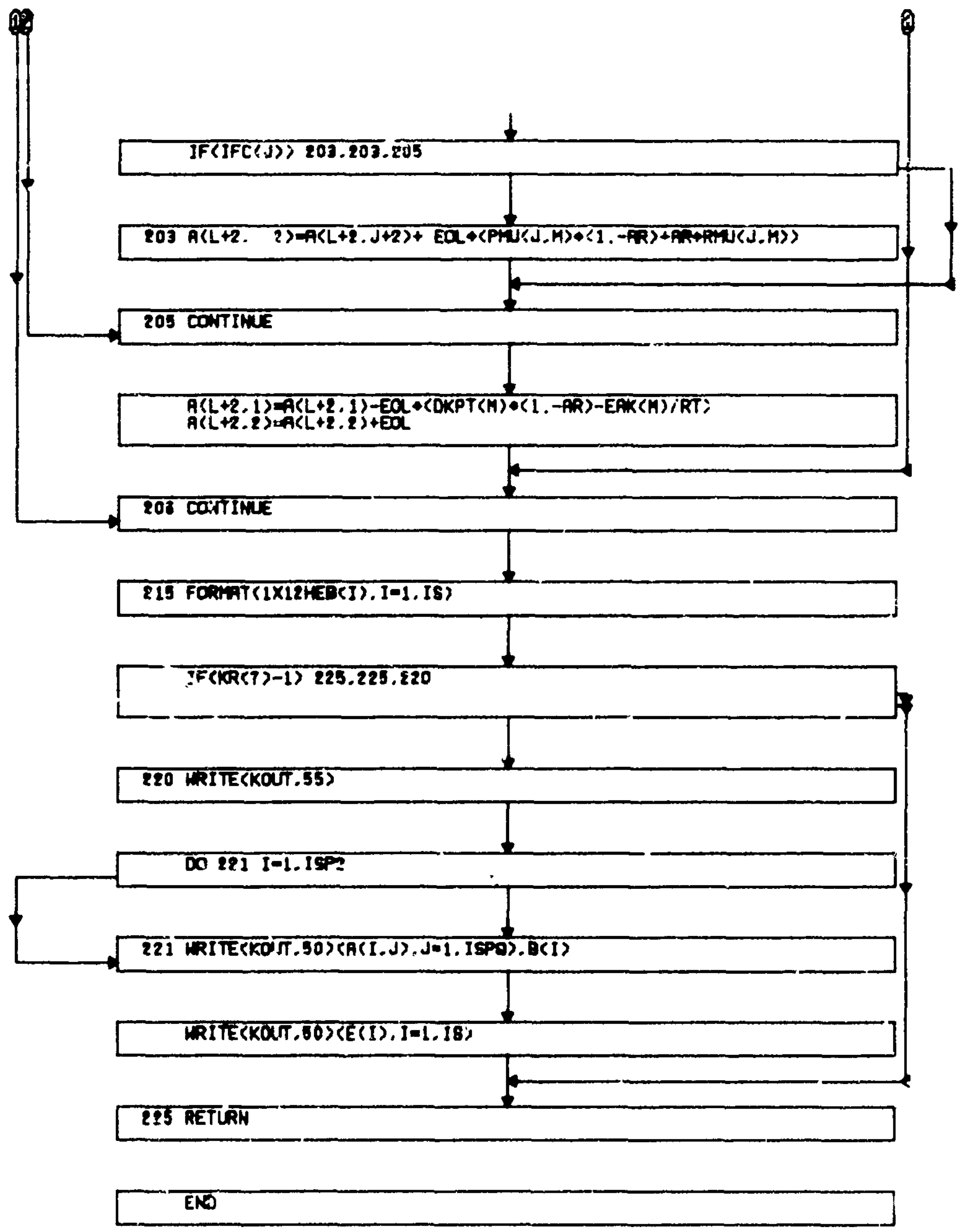

IF (PRMU(L,M)) 110,125,110
110 DO 115 K=1,MM
IF (L - LL(K)) 115,125,115
115 CONTINUE
DUM=ABS(PRMU(L,M)*AMT(M))
IF(ABS(PRMU(L,M))-.001) 125,125,120
C* * * YES,IT IS FOR MASS BALANCE L
120 LL(MM) = L
GOTO 130
125 CONTINUE
C* * *NO, IT IS NOT, ADD INTO ALL MASS BALANCES
126 I1=1
I2 = IS
GOTO 170
C*****REARRANGE ACCORDING TO CONTROLLING REACTION
130 RSIG(MM)=DUM/ES(L)*0.1
DUM1=PRMU(L,M)
PRMU(L,M) = 0.


DO 165 I=1,IS
IF (PRMU(I,M)) 135,165,135
135 DUM2 = PRMU(I,M) / DUM1
IP(I)=1
MP = MM + 1
IF (MT - MP) 155,140,140
140 DO 160 K=MP,MT
MI = MA(K)
PRMU(I,MI) = PRMU(I,MI) - DUM2 * PRMU(L,MI)
IF (ABS(PRMU(I,MI)) - .001) 145,150,150
145 PRMU(I,MI) = 0.
150 CONTINUE
155 DO 160 K=1,ISPQ
160 A(I + 2,K) = A(I + 2,K) - DUM2 * A(L + 2,K)
B(I + 2) = B(I + 2) - DUM2 * B(L + 2)
E(I)=E(I)-DUM2*E(L)
DUM2 = ABS(DUM2)
EB(I) = AMAX1(EB(I) ,DUM2 * EB(L))
165 CONTINUE
PRMU(L,M) = DUM1
C*****ADD CONTROLLING REACTION INTO ITS MASS BALANCE
I1 = L


Q
Q
I2 = L
EOL=E(L)+PMR(M)*PRMU(L,M)
IF(ITS) 170,230,170
230 DELK(M)=(1.-EASE)*ELKM(M)*AMIN1(1.,ABS(EOL/EB(L)))
ELKM(M)=ELKM(M)-DELK(M)
IF(PKR(M)-PKP(M)) 240,170,235
235 PKP(M)=PKP(M)*EXP(-DELK(M))
GO TO 245
240 PKR(M)=PKR(M)*EXP(DELK(M))
245 PMR(M)=PKR(M)-PKP(M)
170 DO 176 J=1,IS
IF(IFC(J)) 171,171,176
171 SUMD = RMU(J,M) * PKR(M) - PMU(J,M) * PKP(M)
DO 175 I=I1,I2
175 A(I + 2,J + 2) = A(I + 2,J + 2) - SUMD * PRMU(I,M)
176 CONTINUE
SUMD = - PKP(M) * DKPT(M) - EAK(M) / RT * PMR(M)
Q

```
      DO 180 I=I1,I2
      DUM1 = PHR(M) * PRMU(I,M)
      A(I+2,2)=A(I+2,2)-DUM1
      A(I + 2,1) = A(I + 2,1) + SUMD * PRMU(I,M)
      E(I)=E(I)+DUM1
      B(I + 2) = B(I + 2) + DUM1
  180 EB(I) = AMAX1(EB(I) ,ABS(PRMU(I,M) * RAT(M)))
      EB(I) =AMAX1(EB(I),ABS(E(I)))
      IF (KR(7) - 1) 200,200,185
  185 WRITE(KOUT,215)
      WRITE(KOUT,50)(EB(I),I=1,IS)
      WRITE(KOUT,50)(E(I),I=1,IS)
  190 WRITE(KOUT,55)
      DO 195 I=1,ISP2
      WRITE(KOUT,50)(A(I,J),J=1,ISPQ),B(I)
  195 CONTINUE
      WRITE(KOUT,5)M,I1,I2,L,LL,MM,MR
      WRITE(KOUT,50)PRMU
  200 CONTINUE
C*****MODIFY COEFFICIENTS TO ACHIEVE LINEARITY AS EQUIL IS APPROACHED
      DO 208 MM=1,MT
      L=LL(MM)
```


IF(L) 201,206,201
201 M=MR(MM)
DUM2=RSIG(MM)
IF(ITS) 250,248,250
248 EESE(L)=E(L)*(1.-EAGE)/(1.+DUM2)
250 E(L)=E(L)-EESE(L)
B(L+2)=B(L+2)-EESE(L)
EB(L)=-EB(L)
AR=1.
EXEL=PKR(M)/PKP(M)
IF(EXEL) 191,191,193
191 EXEL=1.E-38
IF(PKP(M)-PKR(M)) 192,193,193
192 EXEL=1.E+38
193 CONTINUE
EOL=E(L)*DUM2/(DUM2+1.)
DUM1=(1.+DUM2)/(1.+RSIG(MM))
EB(L)=EB(L)*ABS(DUM1)
IF(ABS(EXEL-1.)-.1) 204,204,202
202 DUM1=E(L)/(ELKM(M)*PRMU(L,M))
AR=(DUM1+PKR(M))/PHR(M)
AR=AMAX1(AR,0.)
AR=AMIN1(1.,AR)
204 DO 205 J=1,IS


IF(IFC(J)) 203,203,205
203 A(L+2, 2)=A(L+2,J+2)+ EOL*(PMU(J,M)*(1.-AR)+AR*RMU(J,M))
205 CONTINUE
A(L+2,1)=A(L+2,1)-EOL*(DKPT(M)*(1.-AR)-EAK(M)/RT)
A(L+2,2)=A(L+2,2)+EOL
208 CONTINUE
215 FORMAT(1X12HEB(I),I=1,IS)
IF(KR(7)-1) 225,225,220
220 WRITE(KOUT,55)
DO 221 I=1,ISP2
221 WRITE(KOUT,50)(A(I,J),J=1,ISPQ),B(I)
WRITE(KOUT,60)(E(I),I=1,IS)
225 RETURN
END

30. SUBROUTINE FIRSTG - B29A

a. Function

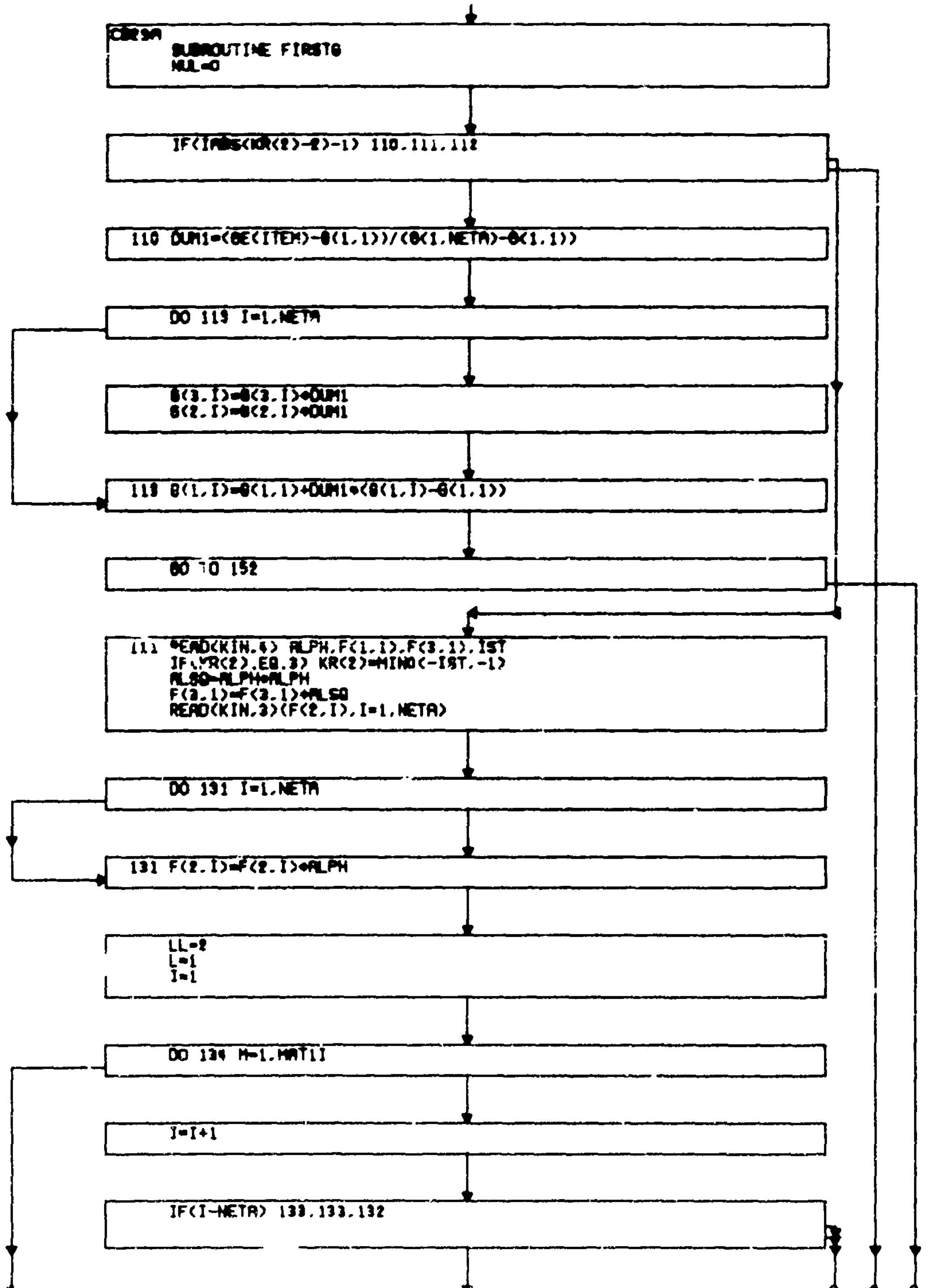
Computes or reads in first guesses for primary variables or instructs program to use values from previous case. Called by SETUP.

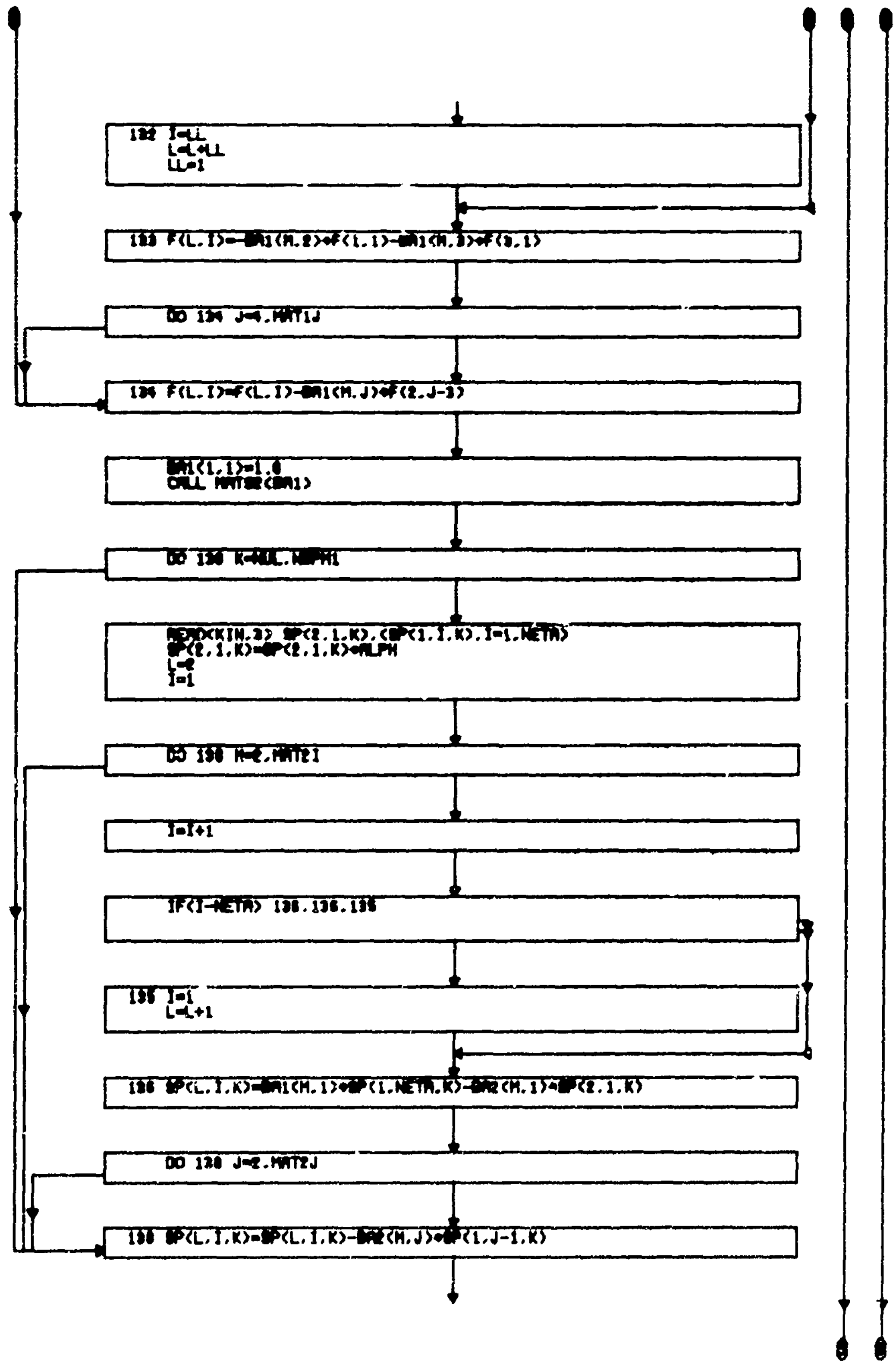
E. Listing

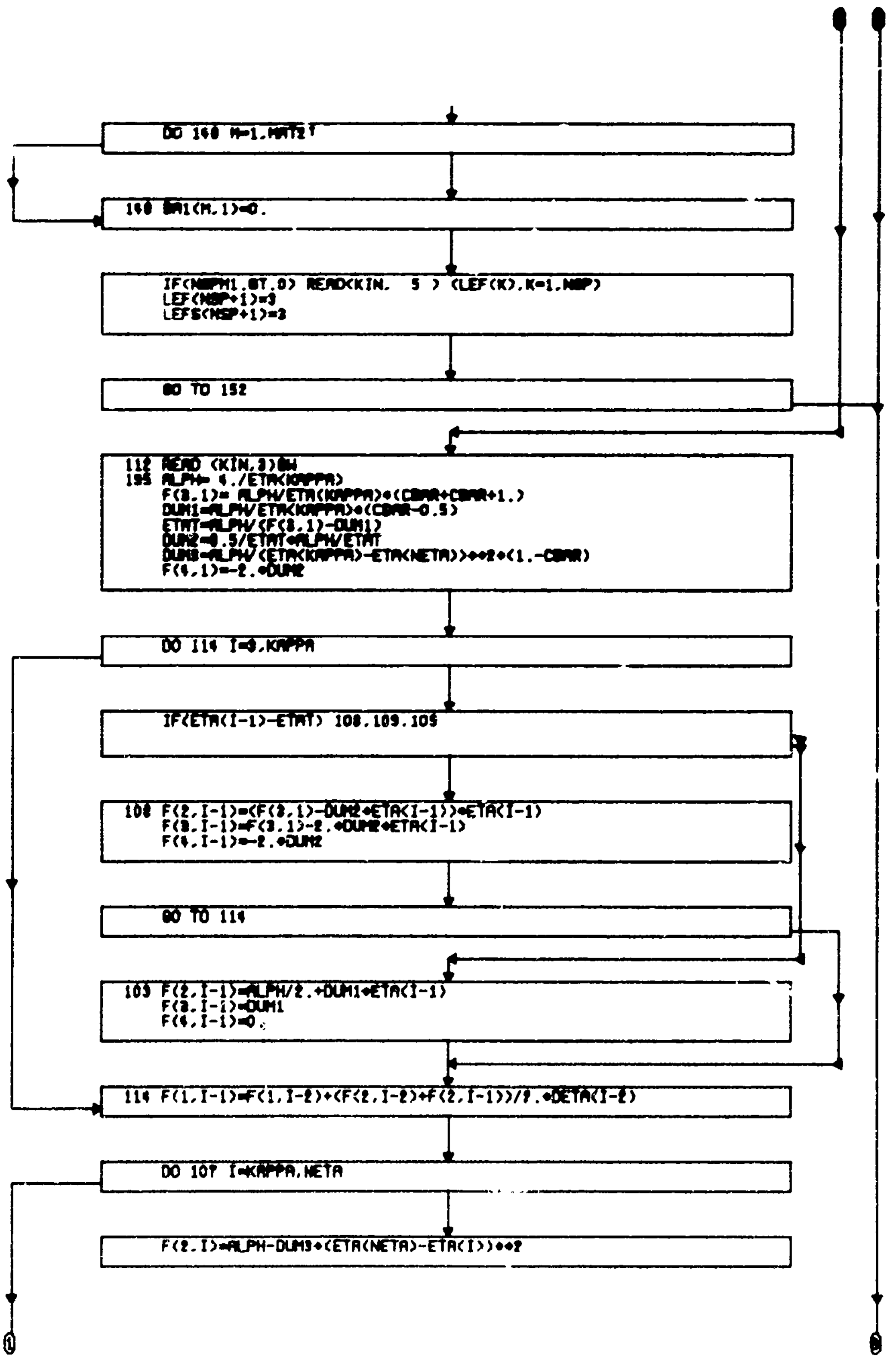
```
      C9294                                                             B29A 001
      SUBROUTINE FIRSTG                                                 B29A 002
      COMMON/HLSCOM/  MOA( 71),  MOR( 71),NSPEC,FR( 71,15),W(3),LEF(10) B29A   3*NEW
     1,LEFS(10),PIEASE,LEFW(10)                                         B29A   4*NEW
      COMMON/ETACOM/ETA(15),DETA(15),MSQ(14),DCU(14),B1(14),B2(14)      B29A   5*NEW
     1,LAR(153),BA1(43,18),BA2(30,15)                                   B29A   6*NEW
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,18,NB29A   7*NEW
     18,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) B29A   8*NEW
     2,R(8),      MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) B29A   9*NEW
     3,KAUXO,JTIME,JSPEC,MD(3)                                          B29A  10*NEW
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 30),S(40),ROKAP(40) B29A  11*NEW
     1,RNCSE,VKAP,NDISC,IDISC(40),NBD(10),MSD(10),ITF( 50),IPRE,RADNO,  B29A  12*NEW
     2CONE,RADFL( 50),RADR(40),RADS(40),IRAD                            B29A  13*NEW
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B29A  14*NEW
    3 FORMAT(8E10.4)                                                    B29A 011*-12
    4 FORMAT(3E10.4,5X15)
    5 FORMAT(40I2)
      NUL=0
      IF(IABS(KR(2)-2)-1) 110,111,112
  110 DUM1=(GE(ITEM)-G(1,1))/(G(1,NETA)-G(1,1))                         B29A 013
      DO 113 I=1,NETA                                                   B29A 014
      G(3,I)=G(3,I)*DUM1                                                B29A 015
      G(2,I)=G(2,I)*DUM1                                                B29A 016
  113 G(1,I)=G(1,1)+DUM1*(G(1,I)-G(1,1))                                B29A 017
      GO TO 152                                                         B29A 018
  111 READ(KIN,4) ALPH,F(1,1),F(3,1),IST
      IF(KR(2).EQ.3) KR(2)=MINO(-IST,-1)
      ALSQ=ALPH*ALPH
      F(3,1)=F(3,1)*ALSQ
      READ(KIN,3)(F(2,I),I=1,NETA)
      DO 131 I=1,NETA
  131 F(2,I)=F(2,I)*ALPH
      LL=2
      L=1
      I=1
      DO 134 M=1,MAT1I
      I=I+1
      IF(I-NETA) 133,133,132
  132 I=LL
      L=L+LL
      LL=1
  133 F(L,I)=-BA1(M,2)*F(1,1)-BA1(M,3)*F(3,1)
      DO 134 J=4,MAT1J
  134 F(L,I)=F(L,I)-BA1(M,J)*F(2,J-3)
      BA1(1,1)=1.0
      CALL MATS2(BA1)
      DO 138 K=NUL,NSPM1
      READ(KIN,3) SP(2,1,K),(SP(1,I,K),I=1,NETA)
      SP(2,1,K)=SP(2,1,K)*ALPH
      L=2
      I=1
      DO 138 M=2,MAT2I
      I=I+1
      IF(I-NETA) 136,136,135
  135 I=1
      L=L+1
  136 SP(L,I,K)=BA1(M,1)*SP(1,NETA,K)-BA2(M,1)*SP(2,1,K)
      DO 138 J=2,MAT2J
```

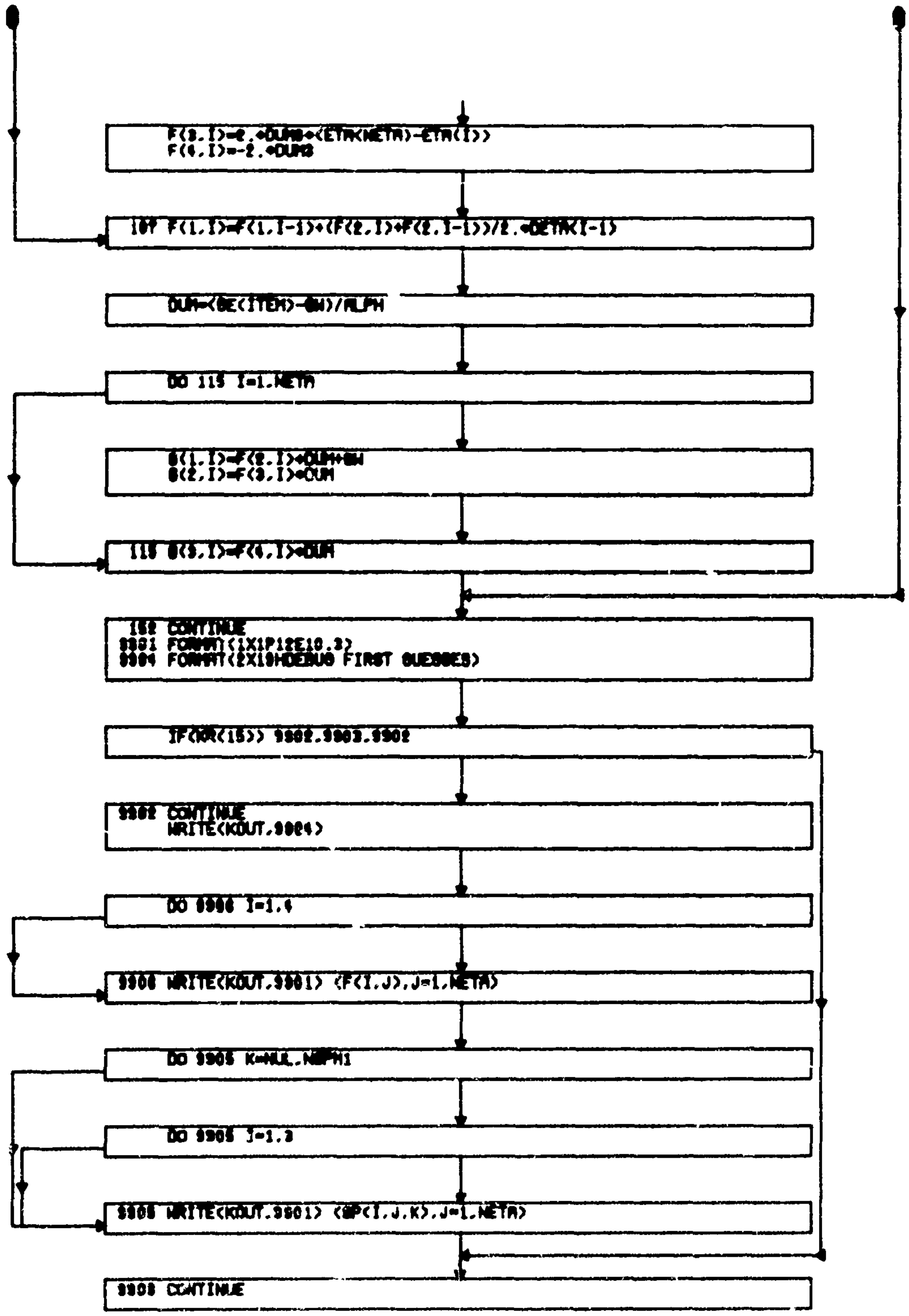
```
  138 SP(L,I,K)=SP(L,I,K)-BA2(M,J)*SP(1,J-1,K)
      DO 140 M=1,MAT21
  140 BA1(M,1)=0.
      IF(NSPM1.GT.0) READ(KIN,  5 ) (LEF(K),K=1,NSP)
      LEF(NSP+1)=3
      LEFS(NSP+1)=3
      GO TO 152                                                         B29A 038
  112 READ (KIN,3)GW                                                    B29A 039
  195 ALPH= 4./ETA(KAPPA)
      F(3,1)= ALPH/ETA(KAPPA)*(CBAR*CBAR+1.)
      DUM1=ALPH/ETA(KAPPA)*(CBAR-3.5)
      ETAT=ALPH/(F(3,1)-DUM1)
      DUM2=0.5/ETAT*ALPH/ETAT
      DUM3=ALPH/(ETA(KAPPA)-ETA(NETA))**2*(1.-CBAR)
      F(4,1)=-2.*DUM2
      DO 114 I=3,KAPPA
      IF(ETA(I-1)-ETAT) 108,109,109
  108 F(2,I-1)=(F(3,1)-DUM2*ETA(I-1))*ETA(I-1)
      F(3,I-1)=F(3,1)-2.*DUM2*ETA(I-1)
      F(4,I-1)=-2.*DUM2
      GO TO 114
  109 F(2,I-1)=ALPH/2.+DUM1*ETA(I-1)
      F(3,I-1)=DUM1
      F(4,I-1)=0.
  114 F(1,I-1)=F(1,I-2)+(F(2,I-2)+F(2,I-1))/2.*DETA(I-2)
      DO 107 I=KAPPA,NETA
      F(2,I)=ALPH-DUM3*(ETA(NETA)-ETA(I))**2
      F(3,I)=2.*DUM3*(ETA(NETA)-ETA(I))
      F(4,I)=-2.*DUM3
  107 F(1,I)=F(1,I-1)+(F(2,I)+F(2,I-1))/2.*DETA(I-1)
      DUM=(GE(ITEM)-GW)/ALPH
      DO 115 I=1,NETA
      G(1,I)=F(2,I)*DUM+GW
      G(2,I)=F(3,I)*DUM
  115 G(3,I)=F(4,I)*DUM
  152 CONTINUE                                                          B29A 059
 9901 FORMAT(1X1P12E10.3)
 9904 FORMAT(2X19HDEBUG FIRST GUESSES)                                  B29A 061
      IF(KR(15)) 9902,9903,9902                                         B29A 062
 9902 CONTINUE                                                          B29A 063
      WRITE(KOUT,9904)                                                  B29A 064
      DO 9906 I=1,4
 9906 WRITE(KOUT,9901) (F(I,J),J=1,NETA)
      DO 9903 K=NUL,NSPM1
      DO 9905 I=1,3
 9905 WRITE(KOUT,9901) (SP(I,J,K),J=1,NETA)
 9903 CONTINUE                                                          B29A 067
      RETURN                                                            B29A 068
      END                                                               B29+ 0
```

c. Flow Chart


C0294
SUBROUTINE FIRSTG
NUL=0
IF(IABS(KR(2)-2)-1) 110,111,112
110 DUM1=(BE(ITEM)-B(1,1))/(B(1,NETA)-B(1,1))
DO 119 I=1,NETA
B(3,I)=B(3,I)*DUM1
B(2,I)=B(2,I)*DUM1
119 B(1,I)=B(1,1)+DUM1*(B(1,I)-B(1,1))
GO TO 152
111 READ(KIN,4) ALPH,F(1,1),F(3,1),IST
IF(KR(2).EQ.3) KR(2)=MIN0(-IST,-1)
ALSQ=ALPH*ALPH
F(3,1)=F(3,1)*ALSQ
READ(KIN,3)(F(2,I),I=1,NETA)
DO 131 I=1,NETA
131 F(2,I)=F(2,I)*ALPH
LL=2
L=1
I=1
DO 134 M=1,MATII
I=I+1
IF(I-NETA) 133,133,132


132 I=LL
L=L+LL
LL=1
133 F(L,I)=-BR1(M,2)*F(1,1)-BR1(M,3)*F(3,1)
DO 134 J=4,MAT1J
134 F(L,I)=F(L,I)-BR1(M,J)*F(2,J-3)
BR1(1,1)=1.0
CALL MATSE(BR1)
DO 138 K=NUL,NSPH1
READ(KIN,3) SP(2,1,K),(SP(1,I,K),I=1,NETA)
SP(2,1,K)=SP(2,1,K)*ALPH
L=2
I=1
DO 138 M=2,MAT2I
I=I+1
IF(I-NETA) 136,136,135
135 I=1
L=L+1
136 SP(L,I,K)=BR1(M,1)*SP(1,NETA,K)-BR2(M,1)*SP(2,1,K)
DO 138 J=2,MAT2J
138 SP(L,I,K)=SP(L,I,K)-BR2(M,J)*SP(1,J-1,K)


DO 140 M=1,MAT2
140 SA1(M,1)=0.
IF(NSPM1.GT.0) READ(KIN, 5) (LEF(K),K=1,NSP)
LEF(NSP+1)=3
LEFS(NSP+1)=3
GO TO 152
112 READ (KIN,3)BW
195 ALPH= 4./ETA(KAPPA)
F(3,1)= ALPH/ETA(KAPPA)*(CBAR+CBAR+1.)
DUM1=ALPH/ETA(KAPPA)*(CBAR-0.5)
ETAT=ALPH/(F(3,1)-DUM1)
DUM2=0.5/ETAT*ALPH/ETAT
DUM3=ALPH/(ETA(KAPPA)-ETA(NETA))**2*(1.-CBAR)
F(4,1)=-2.*DUM2
DO 114 I=3,KAPPA
IF(ETA(I-1)-ETAT) 108,109,109
108 F(2,I-1)=(F(3,1)-DUM2*ETA(I-1))*ETA(I-1)
F(3,I-1)=F(3,1)-2.*DUM2*ETA(I-1)
F(4,I-1)=-2.*DUM2
GO TO 114
109 F(2,I-1)=ALPH/2.+DUM1*ETA(I-1)
F(3,I-1)=DUM1
F(4,I-1)=0.
114 F(1,I-1)=F(1,I-2)+(F(2,I-2)+F(2,I-1))/2.*DETA(I-2)
DO 107 I=KAPPA,NETA
F(2,I)=ALPH-DUM3*(ETA(NETA)-ETA(I))**2
1


F(3,I)=2.*DUM3*(ETA(NETA)-ETA(I))
F(4,I)=-2.*DUM3
107 F(1,I)=F(1,I-1)+(F(2,I)+F(2,I-1))/2.*DETA(I-1)
DUM=(BE(ITEM)-BW)/ALPH
DO 115 I=1.NETA
B(1,I)=F(2,I)*DUM+BW
B(2,I)=F(3,I)*DUM
115 B(3,I)=F(4,I)*DUM
152 CONTINUE
9901 FORMAT(1X1P12E10.3)
9904 FORMAT(2X19HDEBUG FIRST GUESSES)
IF(KR(15)) 9902.9903.9902
9902 CONTINUE
WRITE(KOUT,9904)
DO 9906 I=1.4
9906 WRITE(KOUT,9901) (F(I,J),J=1,NETA)
DO 9905 K=NUL.NBPH1
DO 9905 I=1.3
9905 WRITE(KOUT.9901) (BP(I,J,K),J=1,NETA)
9903 CONTINUE

RETURN

END

31. FUNCTION ERP(X) - B30A

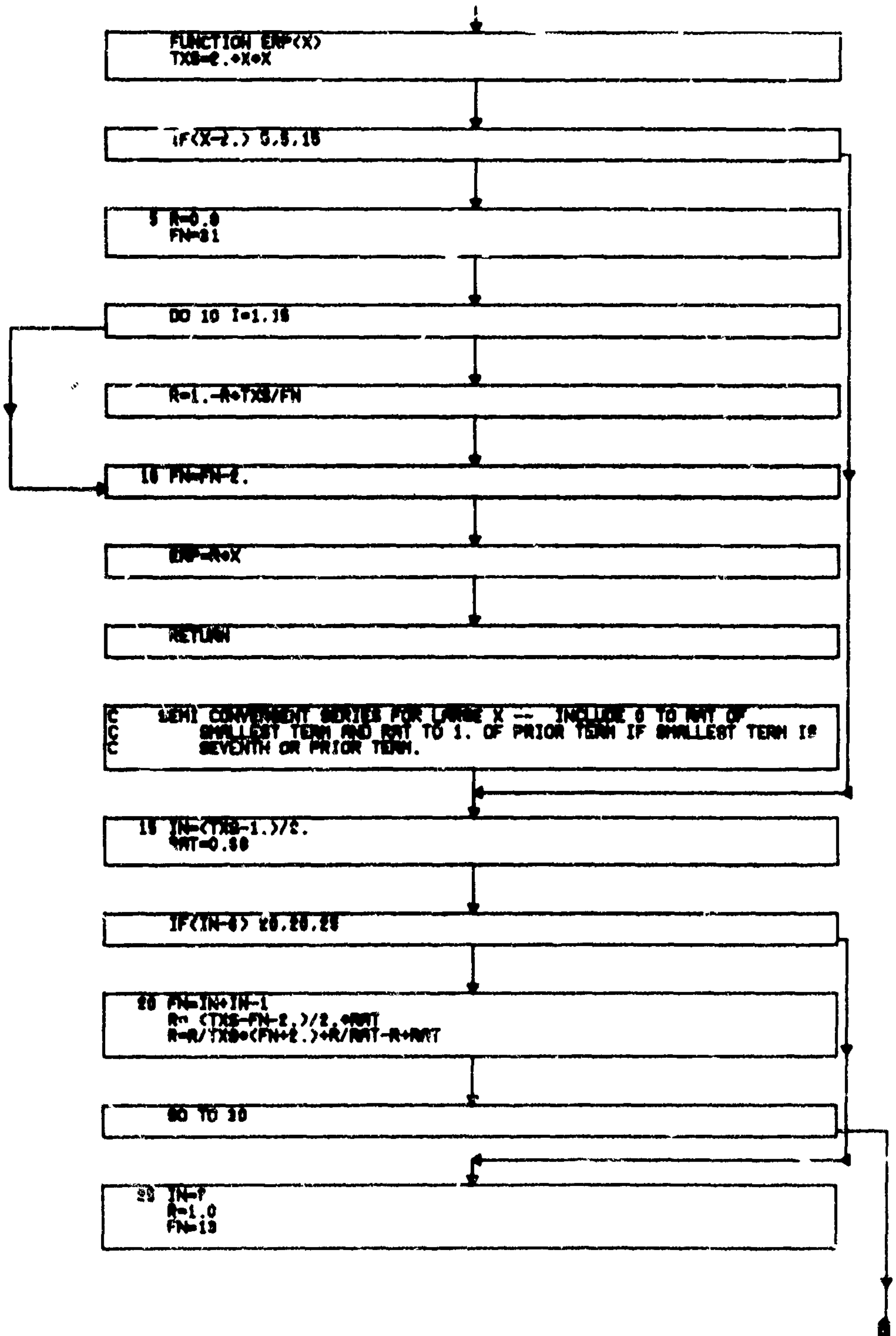
a. Function

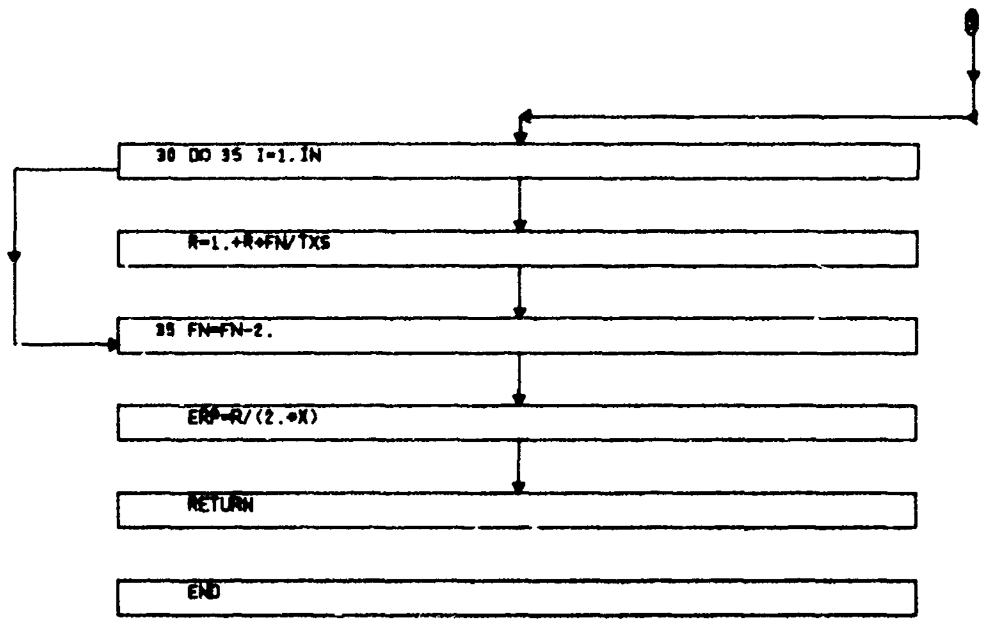
Forms Dawson Integral of X.

b. Listing

```
      FUNCTION ERP(X)
      TXS=2.*X*X
      IF(X-2.) 5,5,15
    5 R=0.8
      FN=31
      DO 10 I=1,15
      R=1.-R*TXS/FN
   10 FN=FN-2.
      ERP=R*X
      RETURN
C     SEMI CONVERGENT SERIES FOR LARGE X --  INCLUDE 0 TO RAT OF
C         SMALLEST TERM AND RAT TO 1. OF PRIOR TERM IF SMALLEST TERM IS
C         SEVENTH OR PRIOR TERM.
   15 IN=(TXS-1.)/2.
      RAT=0.68
      IF(IN-6) 20,20,25
   20 FN=IN+IN-1
      R= (TXS-FN-2.)/2.*RAT
      R=R/TXS*(FN+2.)+R/RAT-R*RAT
      GO TO 30
   25 IN=7
      R=1.0
      FN=13
   30 DO 35 I=1,IN
      R=1.+R*FN/TXS
   35 FN=FN-2.
      ERP=R/(2.*X)
      RETURN
      END
```

c. Flow Chart

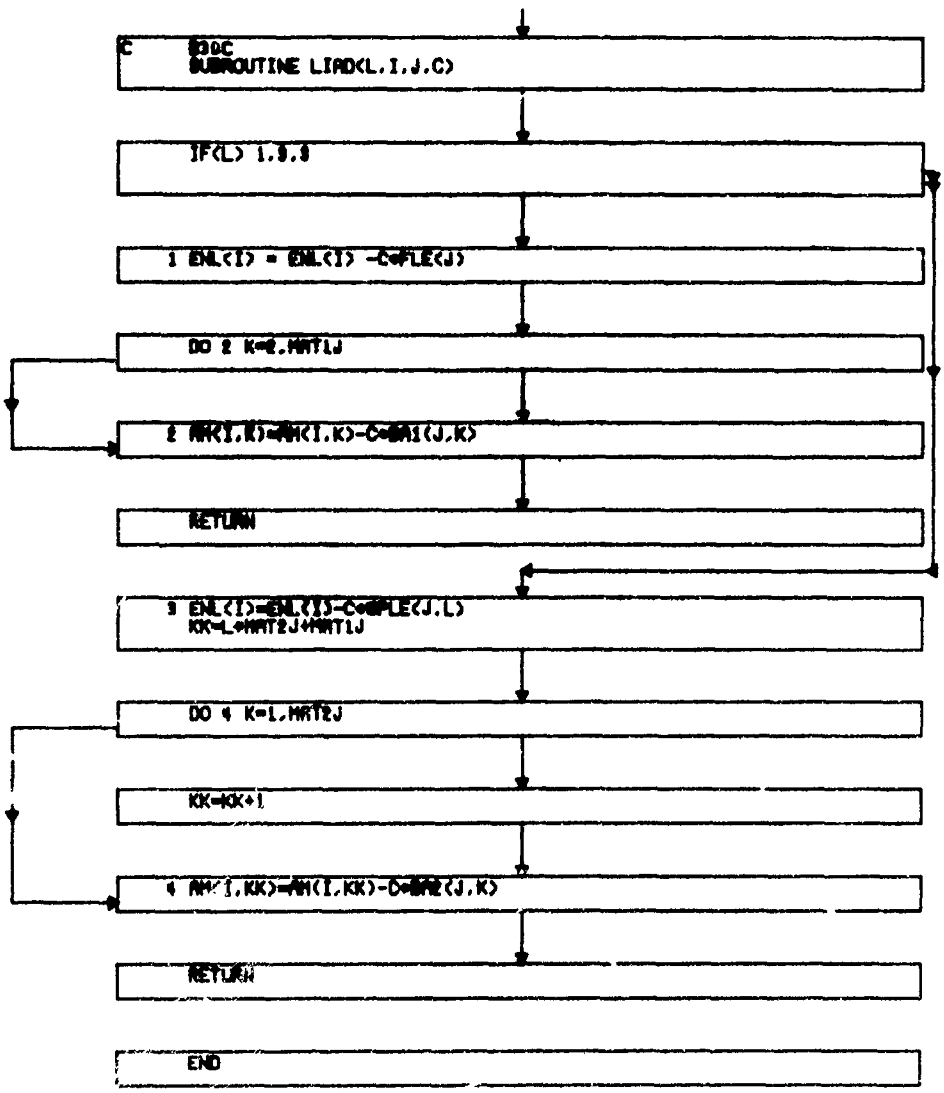

FUNCTION ERP(X)
TXS=2.*X*X
IF(X-2.) 5,5,15
5 R=0.0
FN=31
DO 10 I=1,15
R=1.-R*TXS/FN
10 FN=FN-2.
ERP=R*X
RETURN
C SEMI CONVERGENT SERIES FOR LARGE X -- INCLUDE 0 TO RAT OF
C SMALLEST TERM AND RAT TO 1. OF PRIOR TERM IF SMALLEST TERM IS
C SEVENTH OR PRIOR TERM.
15 IN=(TXS-1.)/2.
RAT=0.50
IF(IN-6) 20,20,25
20 FN=IN+IN-1
R= (TXS-FN-2.)/2.*RAT
R=R/TXS*(FN+2.)+R/RAT-R+RAT
GO TO 30
25 IN=7
R=1.0
FN=13


30 DO 35 I=1,IN
R=1.+R*FN/TXS
35 FN=FN-2.
ERP=R/(2.*X)
RETURN
END

b. Listing

```
      C     B30C
            SUBROUTINE LIAD(L,I,J,C)
            COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM      B30C   3*NEW
           1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)     B30C   4*NEW
           2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)      B30C   5*NEW
           3,FNLEM,GNLEM,SPNLEM( 8),          ENLMM,IFNLM,IGNLM,ISPNLM( 8)    B30C   6*NEW
           4,NENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)              B30C   7*NEW
            COMMON/ETACOM/ETA(15),DETA(15),DSG(14),DCU(14),B1(14),B2(14)      B30C   8*NEW
           1,LAR(153),BA1(43,18),BA2(30,15)                                   B30C   9*NEW
            COMMON/NONCOM/AM(153,153),DVNL(153),TCW,                          B30C  10*NEW
           1VLNKW,DLPH( 9),DLPK( 8, 9),DTMW,DTKW( 8),FLUXJB( 9)               B30C  11*NEW
            COMMON/INTCOM/KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA               **-9
            IF(L) 1,3,3
          1 ENL(I) = ENL(I) -C*FLE(J)
            DO 2 K=2,MAT1J
          2 AM(I,K)=AM(I,K)-C*BA1(J,K)
            RETURN
          3 ENL(I)=ENL(I)-C*SPLE(J,L)
            KK=L*MAT2J+MAT1J
            DO 4 K=1,MAT2J
            KK=KK+1
          4 AM(I,KK)=AM(I,KK)-C*BA2(J,K)
            RETURN
            END                                                               B05A5360
```

c. Flow Chart


C
SUBROUTINE LIAD(L,I,J,C)
IF(L) 1,3,3
1 ENL(I) = ENL(I) -C*FLE(J)
DO 2 K=2,MAT1J
2 AM(I,K)=AM(I,K)-C*BA1(J,K)
RETURN
3 ENL(I)=ENL(I)-C*PLE(J,L)
KK=L*MAT2J+MAT1J
DO 4 K=1,MAT2J
KK=KK+1
4 AM(I,KK)=AM(I,KK)-C*BA2(J,K)
RETURN
END

SECTION III

OPERATION OF BLIMP COUPLED TO A CHARRING ABLATION PROGRAM: THE CABLE CODE

1. INPUT INSTRUCTIONS

The input cards for the CABLE program consist of a nearly complete set of CMA input together with a complete set of BLIMP input, plus a few extra cards. Input instructions for the CMA program from reference 3 will be repeated here for completeness. The BLIMP input instructions are contained in Volume I of this report, and will only be discussed here in general terms. The user should be thoroughly familiar with BLIMP before attempting to use the CABLE program.

a. Restart Card

The CABLE input is started with a control card which is used to indicate restarts, or whether restart information should be saved for future use, and the KR array for the BLIMP program. In the case of restart problems, only this data card, CMA decks for subsequent stations, and the last BLIMP data card (. or ,) together with restart information on logical units 12, 13, and 14 are read in.

Column	Format	Data	Units
10	I1	KCM(10) 0 indicates this is a new case 1 indicates this is a new case, save information for restart 2 indicates this is a restart 3 indicates this is a restart, save information for other restarts	

The next four fields are used only if this is a restart case.

Column	Format	Data	Units
11-15	I5	ITEM. This is the time index from which the problem is to be restarted	
16-20	I5	IS. This is the station index from which the problem is to be restarted	
21-30	I5	NITEM. Total number of times to be considered at each station	
61-80	20I1	KR. This is the KR array for the BLIMP program. In the case of restarts elements 3, 4 and 13-20 of this array may be different from the array in the case being restarted. The new values will then be used at all following times and stations.	

b. CMA Program Input

The input to the Charring Material Thermal Response and Ablation program can conveniently be divided into seven parts. All seven portions of the deck must be present for each run. These individual parts will be described in the following subsections.

(1) Title and Heading Information

The first three cards of the data deck are used to transmit title and heading information to the output. The first 72 columns of each of these cards may be used for the title, the alphameric information in columns 61 through 72 of the third card being used as a page heading on all pages after the first.

(2) Internal-Decomposition Kinetic Data

These three cards supply the constants used in equation (2) of reference 2.* They are supplied according to the following format.

Column	Format	Data	Units
1	I1	Alphabetic character A, B, or C referring to the material components. These must be on the first, second and third cards of this set in order.	
11-20	F10.5	Initial density of component i, ρ_{o_i}	lb/ft^3
21-30	F10.5	Residual density of component i, ρ_{r_i}	lb/ft^3
31-40	F10.3	Pre-exponential factor, B_i	sec^{-1}
41-50	F10.5	Density factor exponent, ψ_i	---
51-60	10.3	Activation energy factor $(E_{a_i}/{}^oR)$	^oR
61-70	F10.5	Minimum temperature of reaction zone	^oR

The last entry in this table, the minimum temperature of the reaction zone, is included only as a means of reducing computational time. Thus, if a nodal temperature is below this value, the program will bypass the fairly complex density-calculation procedure. Also for the case of a nondecomposing reinforcing material, the value of this temperature can be set to a ridiculously high value, thus assuring no decomposition.

*Reference 6 cites relevant data for many materials of interest.

(3) Output Interval Specification and General Program Constants

Two cards are used to provide the program with the values of certain general constants, to establish the time intervals for which output will be obtained, and to specify thermocouple and isotherm output, if desired. (If thermocouples and/or isotherms are called for, additional cards are needed, as described.)

First Card

Column	Format	Data	Units
1-2	I2	Number of nodelets per node (blank implies 10, maximum is 152/total number of nodes)	---
3-5	I3	Total number of nodes (maximum of 38)	---
6	I1	A nonzero punch in this column will cause thermocouple and isotherm output, normally listed with regular output, to also be punched as cards. Punch output on logical unit 7.	---
7-8	I2	Number of thermocouples for which output is desired. (The depths of these thermocouples are specified on additional cards of this group.) Punches here will cause thermocouple temperatures as a function of time to be output at the end of the regular program output. Maximum of this plus subsequent number is 20.	----
9-10	I2	Number of isotherms for which output is desired. (The temperatures of these isotherms are specified on additional cards of this group.) Punches here will cause isotherm depths as a function of time to be output at the end of the regular program listing. Maximum of this plus previous number is 20.	----
11-20	F10.5	Initial value of time	sec
21-30	F10.5	Final value of time	sec
31-40	F10.5	Initial output time interval	sec
41-50	F10.5	Second output time interval	sec
51-60	F10.5	Third output time interval	sec
61-70	F10.5	Maximum time step permitted under any circumstances. If unpunched, this limit will be set equal to 5.0 seconds. Recommended value is 0.001 times total elapsed time.	sec

Second Card

Column	Format	Data	Units
1-10	F10.5	Time of transition from initial to second output time interval	sec
11-20	F10.5	Time of transition from second to third output time interval	sec
21-30	F10.5	Minimum thickness of last ablator node. When, because of surface recession, the last node of the ablation material shrinks below this value, it is combined with the adjacent ablator node. A value equal to the second node's thickness is usually appropriate.	in
31-40 41-50 51-60	F10.5 F10.5 F10.5	Heats of formation of the virgin plastic, the char, and the pyrolysis gas, respectively. These are evaluated at the datum temperature given in columns 71-80.	Btu/lb
61-70	F10.5	Volume fraction or mass fraction of the virgin plastic which is occupied by resin. If mass fraction, it is input as a negative number.	---
71-80	F10.5	Datum temperature for heats of formation given in columns 31-50. This must be the same temperature as used in the BLIMP program thermochemical data cards.	^oR

Additional Cards as Required

Column	Format	Data	Units
1-80	8(F10.5)	If thermocouple and/or isotherm output have been called for, these cards specify thermocouple depths in inches below the original surface and isotherm temperatures in degrees Rankine. Isotherm temperatures must begin on a new card. The total number of thermocouples and isotherms may not exceed 20. If no thermocouples or isotherms are called for, these card(s) are omitted.	in and/or ^oR

(4) Nodal Data

A set of cards equal in number to the number of nodes is used to provide certain information with regard to the initial state of the nodes, their thickness, and the contact resistances between them. In addition, the first card of this set is used to specify the geometric nature of the exposed surface, that is whether it is a flat plate or an internal external radius. The format for these cards is shown below.

Column	Format	Data	Units
1-2	I2	Material number, 1 for virgin plastic, 2 for char.	---
3-12	E10.0	Initial temperature of the node.	^{o}R
13-22	E10.0	Initial cross-sectional area of the node, in any units or normalized on any convenient reference such as the surface area. This data is required only for "general" geometries; for planar, cylindrical, and spherical geometries, and for shapes for which the area varies as a power of the radius the specification of individual nodal areas is not required and these columns should be left blank.	Arbitrary
23-32	E10.0	Initial thickness of the node.	in
33-42	E10.0	<u>First card only</u>. 0 for planar surface; positive value of internal radius or negative of value of external radius for all nonplanar axisymmetric geometries (including spheres and shapes with $A \sim r^{a}$). <u>Second card only</u>. Exponent on radius giving nodal cross-sectional area variation for spherical and other "regular" geometries. Sphere requires 2.0. No entry needed for planar and cylindrical geometries. Must be blank if "general" geometry option is used.	
43-52	E10.0	Contact resistance between this node and the next node.	ft^2-sec-^{o}R/Btu

(5) Back Wall Heat Transfer Conditions; Char and Pyrolysis Zone Criteria

Heat transfer at the back wall is characterized by a convective heat transfer coefficient, an emissivity, and the temperature of a "reservoir" to which heat transfer takes place from the back wall. This card allows the specification of these three quantities. Blanks serve to specify an insulated back wall.

Two additional entries define char edge density and pyrolysis zone edge density according to the following definitions:

$$\rho_{\substack{\text{char}\\ \text{edge}}} = \rho_c + r_c(\rho_p - \rho_c) \tag{1}$$

$$\rho_{\substack{\text{pyrolysis}\\ \text{edge}}} = \rho_c + r_p(\rho_p - \rho_c) \tag{2}$$

The user inputs values for r_c and r_p. Typical values are $r_c = 0.02$ (defining the char edge as occurring where the density is $\rho_c + 0.02(\rho_p - \rho_c)$) and $r_p = 0.98$. If no entries are made for r_c and r_p, 0.02 and 0.98 will be assumed.

Column	Format	Data	Units
1-10	F10.5	Back wall convective coefficient	Btu/sec-ft^2-^{o}R
11-20	F10.5	Back wall emissivity	---
21-30	F10.5	Reservoir temperature	^{o}R
31-40	F10.5	Char zone criterion r_c	---
41-50	F10.5	Pyrolysis zone criterion r_p	---
60	I1	One punch calls for output of thermal conductivity in place of enthalpy in standard output block	

(6) Material Property Tables

In these tables are presented the requisite thermodynamic data for the virgin plastic (material no. 1), and the char layer (material no. 2). These data are input as functions of temperature according to the following format.

Column	Format	Data	Units
1-2	I2	Flag, nominally zero, +1 marks rminal card of last material property table, -1 marks terminal card of other intermediate material property tables	---
3-12	F10.5	Temperature (independent variable)	^{o}R
13-22	F10.5	Specific heat	Btu/lb-^{o}R
23-32	F10.8	Thermal conductivity	Btu/ft-sec-^{o}R
33-42	F10.5	Emissivity	---

The program always expects to find the first two tables for materials 1 and 2 (plastic and char). For problems without decomposition, a "char" table should still be included. It may, of course, be a duplicate of the "plastic" table except for any flags.

The number of temperature points in each table may not exceed 20 or may not be less than 2. The tables must be ordered on either ascending or descending temperatures.

Note that the virgin plastic properties table must precede the char table. Material properties for partially degraded or charred material are formed from weighted averages of the plastic and char properties for the relevant nodal temperatures. The weighting variable is x, the plastic mass fraction (i.e., the

mass fraction of pure plastic, in a simple mixture of pure plastic and pure char, required to yield the local nodal density):

$$x = \frac{\rho_p}{\rho_p - \rho_c}\left(1 - \frac{\rho_c}{\rho}\right) \tag{3}$$

Thus

$$C_p = xC_{p_p} + (1 - x)C_{p_c} \tag{4}$$

The thermal conductivity k will be weighted in the same manner.

(7) Pyrolysis Gas Enthalpy Table

In this table the variation of pyrolysis gas enthalpy with temperature is specified. These values are added to the heat of formation of the pyrolysis gas as specified on the program constant cards. This table is presented on card pairs, the first of which presents a set of temperatures (up to 8), the second containing the corresponding enthalpy values. The first column of the temperature card is used as a flag, nominally blank but containing an integer to mark the last pair of cards. The format for this card pair is given as (I1, F9.5, 7F10.5/8F10.5), implying a basic field length of ten columns for both temperature and enthalpy, with the exception of the first temperature which is restricted to columns 2 through 10. The temperatures should be given in ascending sequence with 8 entries on each card pair (with the exception of the last card pair which may have from one to eight entries). The total number of temperature points in the table may not exceed 30 and may not be less than 2.

c. Grid Points for Interpolation ($\dot{m}_g^*$, $\dot{m}_c^*$)

As discussed in reference 1, CABLE interpolates a matrix of BLIMP solutions in the ($\dot{m}_g^*$, $\dot{m}_c^*$, θ) or ($\dot{m}_g^*$, T, θ) coordinate array to form the boundary conditions for the CMA program. The matrix of ($\dot{m}_g^*$, $\dot{m}_c^*$) or ($\dot{m}_g^*$, T) values are input in this card set. Up to 10 values of $\dot{m}_g^*$ may be read in, with up to 19 values of $\dot{m}_c^*$ and/or T for each $\dot{m}_g^*$ value. The program assumes that everything less than 99. is a normalized mass flux rate, while everything greater than 99. is a temperature. All assigned temperature points should precede all $\dot{m}_c^*$. Up to 10 cards of the following type will be read.

Column	Format	Data	Units
1-4	F4.0	$\dot{m}_g^*$	---
5-80	19F4.0	$\dot{m}_c^*$ or T	dimensionless or °R

Last Card of this Set

Column	Format	Data	Units
1-4	F4.0	View factor for reradiation from the surface	----

d. BLIMP Input

An ordinary BLIMP input deck, complete through but not beyond card group 15, is input next. The input KR(9) and KR(11) values are ignored, however the user should leave the KR9( ) array blank (group 3, card 3, field 2 of the BLIMP input).

e. Other Decks and Last Card

A new CMA deck is input for each body station. These may be duplicates of the deck prepared under (b) above, or it may be altered according to changes in material, thicknesses, etc. The last card of the CABLE input deck should contain a period (.) in column 1, as discussed in Volume I, Section III, Last Group.

2. OUTPUT DESCRIPTION

The output from the CABLE code consists of the usual output from the CMA and BLIMP codes. Program output begins with an output of the input title and heading information, internal decomposition kinetic data, output interval specifications and general program constants, nodal data, material property tables, and pyrolysis gas enthalpy table. All this output is fully labeled and is printed exactly as input by the user. The standard BLIMP summary of input conditions is listed next, including the KR array, eta values, enthalpy, pressure, and radiation flux tables, material compositions, and thermodynamic property curve fit data. An edge gas stagnation solution at time zero (or other initial time) followed by edge gas expansions to the pressure at each body station appears next, these solutions being summarized in an edge gas expansion summary table. Output of boundary layer and in-depth solutions then begins.

The solution output begins with a CMA solution at time zero (or other initial time) which shows the material starting condition. The first BLIMP solution appears next, for the first ($\dot{m}_g^*$, $\dot{m}_c^*$, θ) or ($\dot{m}_g^*$, T, θ) combination. In order to proceed to the next mandatory time, another BLIMP stagnation solution and edge expansion is carried out. BLIMP solutions at the remaining combinations of ($\dot{m}_g^*$, $\dot{m}_c^*$, θ) or ($\dot{m}_g^*$, T, θ) are then run to fill in the interpolation matrix which provides boundary conditions for the CMA program. The CMA program then proceeds, printing output at the specified print interval, until one of two events occurs. If the solution exceeds the limits of the current ($\dot{m}_g^*$, $\dot{m}_c^*$, θ) or ($\dot{m}_g^*$, T, θ)

interpolation cube, new BLIMP solutions are run immediately to fill in the corners of a new interpolation cube. If the CMA solution proceeds up to one of the mandatory solution times, the actual values of $\dot{m}_g^*$ and $\dot{m}_c^*$ or $\dot{m}_g^*$ and T are then used to generate a BLIMP solution at that mandatory time. The CABLE program then proceeds by forming BLIMP solutions for interpolation at the next mandatory time, and carrying out CMA solutions using interpolated BLIMP solutions for boundary conditions until the final mandatory time is reached.

3. SAMPLE PROBLEM

As a demonstration of the CABLE program, a coupled transient solution was run for a sphere-cone reentry body with a nose radius of 0.5 inches and a cone half-angle of eight degrees. Two body points at surface running lengths of 10 and 16 inches (based on the original body shape) were analyzed although there is no reason other than computer time limitations why more body stations could not have been specified. Laminar flow was assumed for the boundary layer to hold the required number of nodes to a minimum. The heat shield material was one-inch thick phenolic carbon with properties as described in reference 6 and was insulated at the back face. Total flight time from 300,000 feet was 27 seconds with an impact velocity of 17,000 ft/sec. Pressure ratio P/P_o at the body stations of interest were assumed to be 0.0262 and 0.0195 for the entire 27 seconds. Mandatory BLIMP solution times were 0.0, 7.0, 14.0, 18,0, 21.0, 23.0, 25.0, and 27.0 seconds. Due to the plateau-like behavior of this carbonaceous material, interpolation on surface temperature rather than $\dot{m}_c^*$ was selected for the entire flight. Temperatures from 500°R to 9500°R at 500°R intervals were used.

Based on observation of the results of this sample case, it appears that the maximum allowed time step of 0.5 seconds input for this case was too large, allowing oscillations of the pyrolysis gas mass flux which in turn required an inordinate number of BLIMP solutions for interpolation. The value suggested in Subsection 1.b above of 0.001 times the maximum time (0.027 seconds) would have resulted in a more stable solution.

a. Input for CABLE Sample Problem

```
CMA DECK FOR CABLE ANALYSIS OF PHENOLIC CARBON HEATSHIELD
TWO STATIONS, ONE INCH THICK PH. CARB., PROPERTIES FROM NASA CR 72301
KIRTLAND SAMPLE PROBLEM NO. 5
A           60.75      32.4       4.48     F93.0       3.68      F4600.
B           20.25      0.         1.40     E43.0       1.54      E41000.
C           97.4       97.4       0.       0.          0.          9000.
  15        0.         27.        1.       1.          1.          .02        0.5
1.          2.         .02        -376.5   0.          0.          -.330      536.
 1530.                 .01         -1.788
 1530.                 .01
 1530.                 .02
 1530.                 .02
 1530.                 .03
 1530.                 .03
 1530.                 .03
 1530.                 .05
 1530.                 .05
 1530.                 .05
 1530.                 .10
 1530.                 .10
 1530.                 .15
 1530.                 .15
 1530.                 .20
1.0   E-10           530.
    530.      0.210     2.230-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
    800.      0.360     2.540-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   1160.      0.360     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   1500.      0.472     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   2000.      0.486     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   3000.      0.493     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   4000.      0.498     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
   5000.      0.500     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
-1 6000.      0.500     2.940-04    1.000          MX4926 (VIRGIN,60 DEG LAYUP)
    530.      0.210     2.230-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   1000.      0.430     2.980-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   1500.      0.472     3.035-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   2000.      0.484     3.906-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   3000.      0.493     8.490-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   4000.      0.498    14.300-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
   5000.      0.500    20.950-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
+1 6000.      0.500    28.100-04    1.000          MX4926 (CHAR   ,60 DEG LAYUP)
1    900.0    1800.0    2700.0     3600.0     4500.0     5400.0     6300.0
   -1782.0    -930.2    195.6      [illegible]     3600.0     4696.0     6152.0
     500100015002000250030003500040[illegible]05000550060006500700075008000850090009500
.05  5001000150020002500300035004000450050005500600065007000750080008500900009500
 .1  5001000150020002500300035004000450050005500600065007000750080009500900009500
.15  500100015002000250030003500400045005000[illegible]00065007000750080008500900009500
 .2  5001000150020002500300035004000450050005500600065007000750080008500900009500
.25  50010001500200025003000350040004500500055006000[illegible]07000750080008500900009500
 .3  5001000150020002500300035004000450050005500600065007000750080008500900009500
.35  5001000150020002500300035004000450050005500600065007000750080008500900009500
 .4  5001000150020002500300035004000450050005500600065007000750080008500900009500
 .5  5001000150020002500300035004000450050005500600065007000750080008500900009500
     (blan  card)
```

```
1010440122420?   1   CABLF SOLUTION FOR PH. CARBON HEATSHIELD
 4
 8
0.          7.          14.         18.         21.         23.         25.         27.
 2
0.8333      1.3333
 7
0.          .2          .6          1.2         2.          3.          5.
 5    .80
0.149       0.2187
.001123      0509       1.033       8.22        40.4        107.3       203.        267.5
10000.      10120.      10230.      10180.      9870.       9160.       7700.       5700.

100.
 5   .431   23.4        32.         3.467        106.7                              800.
  1HYDROGEN       1.00797         6.
  6CARBON        12.011           6.          1.
  7NITROGEN      14.008  -.765
  8OXYGEN        16.000  -.235     1.
 99ELECTRON       0.00055
  3  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                           C3
 189670+6 366220+5 146441+2 622536-4-168227+7 798410+2  500. 3000.1    0.C3
 189670+6 366220+5 144782+2 792232-4-646877+6 798410+2 3000. 5000.1    0.C3
  1  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           C*
 000000-0 144120+5 586075+1 953976-4-766621+6 121290+2  500. 3000.2 100.C*
 000000-0 144120+5 485134+1 291605-3 307202+7 121290+2 3000. 5000.2 100.C*
  1  6  1  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           CO
-264170+5 223570+5 865040+1 117021-3-898211+6 653700+2  500. 3000.1    0.CO
-264170+5 223570+5 115496+2-424139-3-131563+8 653700+2 3000. 5000.1    0.CO
  1  1  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                           H
 521020+5 134230+5 480223+1 555469-4 173095+6 388620+2  500. 3000.1    0.H
 521020+5 134230+5 308752+1 315025-3 929744+7 388620+2 3000. 5000.1    0.H
  2  7  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           N2
 000000-0 221650+5 862699+1 116090-3-103715+7 637650+2  500. 3000.1    0.N2
 000000-0 221650+5 984175+1-116232-3-612728+7 637650+2 3000. 5000.1    0.N2
  1  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           C
 170886+6 135500+5 444433+1 228125-3 409830+6 492870+2  500. 3000.1    0.C
 170886+6 135500+5 412212+1 261908-3 262886+7 492870+2 3000. 5000.1    0.C
  4  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           CH4
-178950+5 530790+5 230948+2 677896-3-755061+7 825970+2  500. 3000.1    0.CH4
-178950+5 530790+5 236053+2 374323-3-368234+7 825970+2 3000. 5000.1    0.CH4
  1  6  1  7  0  0  0  0  0  0  0  0  0  0JANAF 12/62                           CN
 109000+6 232490+5 655906+1 115326-2 479517+6 669760+2  500. 3000.1    0.CN
 109000+6 232490+5 988013+1 313855-3-649453+7 669760+2 3000. 5000.1    0.CN
  1  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 03/61                           CH
 142006+6 221300+5 826079+1 302211-3-100184+7 616120+2  500. 3000.1    0.CH
 142006+6 221300+5 707091+1 463281-3 552860+7 616120+2 3000. 5000.1    0.CH
  1  1  1  6  1  7  0  0  0  0  0  0  0  0JANAF 03/61                           CHN
 312000+5 355930+5 137023+2 552243-3-228955+7 758620+2  500. 3000.1    0.CHN
 312000+5 355930+5 178895+2-295052-3-183671+8 758620+2 3000. 5000.1    0.CHN
  1  1  1  6  1  8  0  0  0  0  0  0  0  0JANAF 03/61                           CHO
```

```
-290000+4 323670+5 128033+2 300638-3-201721+7 789830+2  500. 3000.1    0.CHO
-290000+4 323670+5 103028+2 633312-3 121615+8 789830+2 3000. 5000.1    0.CHO
 1  6  2  8  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   CO2
-940540+5 365350+5 144559+2 210386-3-182392+7 798480+2  500. 3000.1    0.CO2
-940540+5 365350+5 156451+2-381561-4-602768+7 798480+2 3000. 5000.1    0.CO2
 2  6  0  0  0  0   0  0  0   0  0  0  0  0JANAF 9/61                    C2
 198999+6 246990+5 776612+1 696081-3 185649+6 685519+2  500. 3000.1    0.C2
 198999+6 246990+5 104162+2 566841-4-640205+7 685519+2 3000. 5000.1    0.C2
 2  1  2  6  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   C2H2
 541900+5 482570+5 189960+2 769044-3-409039+7 849690+2  500. 3000.1    0.C2H2
 541900+5 482570+5 203952+2 389062-3-645297+7 849690+2 3000. 5000.1    0.C2H2
 1  1  1  8  0  0   0  0  0   0  0  0  0  0JANAF 12/60                   HO
 933000+4 214040+5 773193+1 394386-3-973561+6 613820+2  500. 3000.1    0.HO
 933000+4 214040+5 965144+1-443528-4-686115+7 613820+2 3000. 5000.1    0.HO
 2  1  0  0  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   H2
 000000-0 212100+5 711963+1 621950-3-712694+6 484650+2  500. 3000.1    0.H2
 000000-0 212100+5 681794+1 589854-3 265106+7 484650+2 3000. 5000.1    0.H2
 2  1  1  8  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   H2O
-577980+5 302010+5 112254+2 811397-3-260800+7 684210+2  500. 3000.1    0.H2O
-577980+5 302010+5 157278+2-191548-3-173599+8 684210+2 3000. 5000.1    0.H2O
 1  7  0  0  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   N
 112965+6 134370+5 486944+1 383516-4 958460+5 480900+2  500. 3000.1    0.N
 112965+6 134370+5 428957+1 240844-3-417273+6 480900+2 3000. 5000.1    0.N
 1  7  1  8  0  0   0  0  0   0  0  0  0  0JANAF 06/63                   NO
 215800+5 227000+5 877623+1 899031-4-789656+6 688490+2  500. 3000.1    0.NO
 215800+5 227000+5 916260+1 657885-5-212519+7 688490+2 3000. 5000.1    0.NO
 1  8  0  0  0  0   0  0  0   0  0  0  0  0JANAF 06/62                   O
 595590+5 135220+5 497228+1 380768-5 154749+5 500960+2  500. 3000.1    0.O
 595590+5 135220+5 657489+1-224268-3-891782+7 500960+2 3000. 5000.1    0.O
 2  8  0  0  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   O2
 000000-0 234460+5 804370+1 510872-3-152718+6 679730+2  500. 3000.1    0.O2
 000000-0 234460+5 103071+2 290991-4-783079+7 679730+2 3000. 5000.1    0.O2
 1 99  0  0  0  0   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         E-
          +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1    E-
          +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1    E-
 1  6 -1 99  0  0   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1    C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1    C+
 1  7 -1 99  0  0   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1    N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1    N+
 2  8  1 99  0  0   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1    O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1    O2-
 1  6  1  8 -1 99   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1    CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1    CO+
 1  7  1  8 -1 99   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1    NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1    NO+
 1  8 -1 99  0  0   0  0  0   0  0  0  0  0CONVAIR ZPH-122 12/61         O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1    O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1    O+
   (blank card)
```

```
.0262      .0195
          (3 blank cards)

CMA DECK FOR CABLE ANALYSIS OF PHENOLIC CARBON HEATSHIELD
TWO STATIONS. ONE INCH THICK PH. CARB.. PROPERTIES FROM NASA CR 72301
KIRTLAND SAMPLE PROBLEM NO. 5
A          60.75      32.4       4.48      E93.0       3.68     E4600.
B          20.25      0.         1.40      E43.0       1.54     E41000.
C          97.4       97.4       0.         0.         0.         90000.
  15       0.         27.        1.         1.         1.         .02        0.5
1.         2.         .02        -376.5     0.         0.         -.330      536.
 1530.                .01          -1.788
 1530.                .01
 1530.                .02
 1530.                .02
 1530.                .03
 1530.                .03
 1530.                .03
 1530.                .05
 1530.                .05
 1530.                .05
 1530.                .10
 1530.                .10
 1530.                .15
 1530.                .15
 1530.                .20
1.0   F-10           530.
    530.      0.210     2.230-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
    800.      0.360     2.540-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   1160.      0.360     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   1500.      0.472     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   2000.      0.484     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   3000.      0.493     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   4000.      0.498     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
   5000.      0.500     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
-1 6000.      0.500     2.940-04    1.000           MX4926 (VIRGIN.60 DEG LAYUP)
    530.      0.210     2.230-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   1000.      0.430     2.980-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   1500.      0.472     3.035-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   2000.      0.484     3.906-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   3000.      0.493     8.490-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   4000.      0.498    14.300-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
   5000.      0.500    20.950-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
+1 6000.      0.500    28.100-04    1.000           MX4926 (CHAR   .60 DEG LAYUP)
1     900.0     1800.0     2700.0     3600.0     4500.0     5400.0     6300.0
   -1782.0     -930.2      195.6     2289.0     3600.0     4696.0     6152.0
      5001000150020002500300035004000450050005500600065007000750080008500900095000
.05   50010001500200025003000350040004500500055006000650070007500800085009000950
 .1   50010001500200025003000350040004500500055006000650070007500800085009000950
.15   50010001500200025003000350040004500500055006000650070007500800085009000950
 .2   50010001500200025003000350040004500500055006000650070007500800085009000950
```

```
.25 500100015002000250030003500400045005000550060006500700075008000850090009500
.3  500100015002000250030003500400045005000550060006500700075008000850090009500
.35 500100015002000250030003500400045005000550060006500700075008000850090009500
.4  500100015002000250030003500400045005000550060006500700075008000850090009500
.5  500100015002000250030003500400045005000550060006500700075008000850090009500
         (blank card)
```

b. Output from CABLE Sample Problems

Due to the very large quantity of output from the CABLE program, only a small portion is included here in the sample output. That portion consists of the input summary for CMA and BLIMP, the edge expansion at time zero, the first mandatory BLIMP solution at time zero, the BLIMP stagnation solution and edge expansion for the second mandatory time, the eight BLIMP solutions to be used for interpolation, the CMA output for the first seven seconds, and the second mandatory BLIMP solution (at 7.0 seconds).

```
AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM
                                                                PAGE  1

CMA DECK FOR CABLE ANALYSIS OF PHENOLIC CARBON HEATSHIELD
TWO STATIONS, ONE INCH THICK PH, CARB., PROPERTIES FROM NASA CR 72301
KIRTLAND SAMPLE PROBLEM NO. 5

              ---REACTION KINETIC EQUATION---

   DRHO/DTIME = GAMMA ( BA*EXP(-EA/T)RHOOA((RHOA-RHORA)/RHOOA)**PSIA )
              + GAMMA ( BB*EXP(-EB/T)RHOOB((RHOB-RHORB)/RHOOB)**PSIB )
           +(1-GAMMA)( BC*EXP(-EC/T)RHOOC((RHOC-RHORC)/RHOOC)**PSIC )
              ---REACTION KINETIC CONSTANTS---

   REACTION  RHOO      RHOR        B         PSI        E       T REAC
               (LB/CU FT)        (1/SEC)               (DEG R)  (DEG R)
      A      60.75     32.40     .4480+10    3.00     .3680+05    600.
      B      20.25       .00     .1400+05    3.00     .1540+05   1000.
      C      97.40     97.40     .0000        .00     .0000     90000.
    RESIN VOLUME FRACTION, GAMMA =  .372(MASS FRACTION =  .330)

              ---TIME INCREMENT INFORMATION---

INITIAL TIME (SEC)    .000                         FINAL TIME (SEC)  27.00

OUTPUT INTERVAL = 1.000 SEC FROM INITIAL TIME UNTIL  1.000 SEC
OUTPUT INTERVAL = 1.000 SEC FROM  1.000 SEC UNTIL  2.000 SEC
OUTPUT INTERVAL = 1.000 SEC FROM  2.000 SEC UNTIL FINAL TIME

MAXIMUM TIME STEP = .50 SECONDS
```

---NODAL DATA---

NODE NO.	MATL NO.	TEMPERATURE (DEG.RANKINE)	RELATIVE AREA	THICKNESS (INCHES)	NODAL DEPTH (INCHES)	CONT.RESISTANCE (SQFT-H-DEG/BTU)
1	1	530.00	.1788+01	.01000	.0000000*	-.0000
2	1	530.00	.1773+01	.01000	.015000	-.0000
3	1	530.00	.1758+01	.02000	.030000	-.0000
4	1	530.00	.1738+01	.02000	.050000	-.0000
5	1	530.00	.1713+01	.03000	.075000	-.0000
6	1	530.00	.1683+01	.03000	.105000	-.0000
7	1	530.00	.1653+01	.03000	.135000	-.0000
8	1	530.00	.1613+01	.05000	.175000	-.0000
9	1	530.00	.1563+01	.05000	.225000	-.0000
10	1	530.00	.1513+01	.05000	.275000	-.0000
11	1	530.00	.1436+01	.10000	.350000	-.0000
12	1	530.00	.1338+01	.10000	.450000	-.0000
13	1	530.00	.1213+01	.15000	.575000	-.0000
14	1	530.00	.1063+01	.15000	.725000	-.0000
15	1	530.00	.8880-00	.20000	.900000	-.0000

*INITIAL EXTERNAL RADIUS 1.788 AREA PROP.TO RADIUS**1.00
MINIMUM THICKNESS OF LAST ABLATOR NODE (INCHES) .0200
THERE ARE 10 NODELETS ASSIGNED TO EACH ABLATING NODE

BACK WALL CONVECTION COEF BTU/FTSQ-SEC-DEG R	BACK WALL EMISSIVITY	RESERVOIR TEMPERATURE
.0000	-.000	530.00

---HEAT OF FORMATION OF MATERIAL CONSTITUENTS---
(BTU/LB)

PLASTIC	CHAR	GAS
-376.50	.00	.00

ENTHALPY DATUM TEMPERATURE = 536.000 DEG RANKINE

---MATERIAL THERMAL PROPERTY DATA---

MATERIAL NO. 1	MATERIAL NO. 2	MATERIAL NOS. 3 THROUGH 10
VIRGIN PLASTIC	CHAR	BACK-UP

MATERIAL NO. 1 DENSITY = 91.300 LB/CU FT

TEMPERATURE (DEG R)	SPECIFIC HEAT (BTU/LB-DEG)	CONDUCTIVITY (BTU/FT-SEC-DEG)	SENSIBLE ENTHALPY (BTU/LB)	EMISSIVITY
530.00	.2100	.0002230	-1.71	1.0000
800.00	.3600	.0002560	75.24	1.0000
1160.00	.3400	.0002940	204.84	1.0000
1500.00	.4720	.0002940	346.26	1.0000
2000.00	.4840	.0002940	585.26	1.0000
3000.00	.4930	.0002940	1073.78	1.0000
4000.00	.4980	.0002940	1569.28	1.0000
5000.00	.5000	.0002940	2068.28	1.0000
6000.00	.5000	.0002940	2568.28	1.0000

MATERIAL NO. 2 DENSITY = 73.222 LB/CU FT

TEMPERATURE (DEG R)	SPECIFIC HEAT (BTU/LB-DEG)	CONDUCTIVITY (BTU/FT-SEC-DEG)	SENSIBLE ENTHALPY (BTU/LB)	EMISSIVITY
530.00	.2100	.0002230	-1.92	1.0000
1000.00	.4300	.0002980	148.48	1.0000
1500.00	.4720	.0003035	375.98	1.0000
2000.00	.4840	.0003900	612.98	1.0000
3000.00	.4930	.0008490	1101.48	1.0000
4000.00	.4980	.0014300	1596.98	1.0000
5000.00	.5030	.0020950	2083.98	1.0000
6000.00	.5000	.0026100	2565.98	1.0000

---RESIN DECOMPOSITION GAS SENSIBLE ENTHALPY---

TEMPERATURE (DEG R)	900.00	1800.00	2700.00	3600.00	4500.00
ENTHALPY (BTU/LB)	-1782.00	-930.20	175.40	2289.00	3450.00
TEMPERATURE (DEG R)	5400.00	6300.00			
ENTHALPY (BTU/LB)	4696.00	6152.00			

BOUNDARY LAYER INTEGRAL MATRIX PROGRAM (BLIMP)

AEROTHERM CORPORATION,PALO ALTO,CALIF (RMK,EPB) 09 OCT 69 13:50:25

CASE CABLE SOLUTION FOR PH, CARBON HEATSHIELD

CONTROL NUMBERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	1	0	1	0	4	4	0	1	2	2	4	2	0	2	-0	-0	-0	1	-0	-0

PUNCH CONTROL
IDENT JSPEC
-0

U/UE TO NORM, ETA	NODAL PT, AT WHICH ETA NORM,	ETA VALUES							
8,000-01	5	0,000	2,000-01	6,000-01	1,200+00	2,000+00	3,000+00	5,000+00	
TIME,SEC		0,00000	7,00000+00	1,40000+01	1,80000+01	2,10000+01	2,30000+01	2,50000+01	2,70000+01
TOTAL ENTHALPY,BTU/LB		1,00000+04	1,01200+04	1,02500+04	1,01400+04	9,87000+03	9,16000+03	7,70000+03	5,70000+03
PRESSURE,ATM		1,12300-03	5,09000-02	1,03300+00	8,22000+00	4,04000+01	1,07300+02	2,03000+02	2,67500+02
RAD FLUX,B/SF2		-0,00000	-0,00000	-0,00000	-0,00000	-0,00000	-0,00000	-0,00000	-0,00000

```
T.ME    .00000    SECONDS - - - - - - - - - - - - - - - - - - - - - - - - - - - - 09 OCT 69 13150125

RELATIVE ELEMENTAL COMPOSITIONS, ATOMIC WTS/UNIT MASS
  AT.NO.   ELEMENT    ATOMIC WT     EDGE GAS    PYRO.GAS 1      CHAR 1     PYRO.GAS 2      CHAR 2     PYRO.GAS 3      CHAR 3
    1     HYDROGEN     1.00797      .0000000     .0637526      .0000000    -.0000000     -.0000000    -.0000000     -.0000000
    6     CARBON      12.01100      .0000000     .0637526      .0832570    -.0000000     -.0000000    -.0000000     -.0000000
    7     NITROGEN    14.00800      .0546117     .0000000      .0000000    -.0000000     -.0000000    -.0000000     -.0000000
    8     OXYGEN      16.00000      .0146875     .0106254      .0000000    -.0000000     -.0000000    -.0000000     -.0000000
   99     ELECTRON      .00055      .0000000     .0000000      .0000000    -.0000000     -.0000000    -.0000000     -.0000000

THERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FOR FORMAT)

1.  6 3.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60                            C3
  .18947+06   .36622+05   .14644+02   .62254-04  -.16823+07   .79841+02  500.0000  3000.0000 1
  .18947+06   .36622+05   .14478+02   .79223-04  -.64688+06   .79841+02 3000.0000  5000.0000 1
1.  6 1.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            C+
  .00000      .14412+05   .58607+      .95398-04  -.76662+06   .12129+02  500.0000  3000.0000 2
  .00000      .14412+05   .48513+ 1    .29161-03   .30720+07   .12129+02 3000.0000  5000.0000 2
1.  6 1.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CO
 -.26417+05   .22357+05   .86504+01   .11702-03  -.89821+06   .65370+02  500.0000  3000.0000 1
 -.26417+05   .22357+05   .11550+02  -.42414-03  -.13156+08   .65370+02 3000.0000  5000.0000 1
1.  1 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60                            H
  .52102+05   .13423+05   .48022+01   .55547-04   .17310+06   .38862+02  500.0000  3000.0000 1
  .52102+05   .13423+05   .30875+01   .31502-03   .92974+07   .38862+02 3000.0000  5000.0000 1
1.  7 2.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            N2
  .00000      .22165+05   .86270+01   .11609-03  -.10372+07   .63765+02  500.0000  3000.0000 1
  .00000      .22165+05   .98417+01  -.11623-03  -.61273+07   .63765+02 3000.0000  5000.0000 1
1.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            C
  .17089+06   .13550+05   .44443+01   .22812-03   .40983+06   .49287+02  500.0000  3000.0000 1
  .17089+06   .13550+05   .41221+01   .26191-03   .26289+07   .49287+02 3000.0000  5000.0000 1
1.  1 1.  5 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CH4
 -.17895+05   .53079+05   .23095+02   .67790-03  -.75506+07   .82597+02  500.0000  3000.0000 1
 -.17895+05   .53079+05   .23605+02   .37432-03  -.34823+07   .82597+02 3000.0000  5000.0000 1
1.  6 1.  7 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62                            CN
  .10900+06   .23249+05   .65591+01   .11533-02   .47952+06   .66974+02  500.0000  3000.0000 1
  .10900+06   .23249+05   .98801+01   .33385-03  -.64945+07   .66974+02 3000.0000  5000.0000 1
1.  1 1.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CH
  .14201+06   .22130+05   .82608+01   .30221-03  -.10018+07   .61612+02  500.0000  3000.0000 1
  .14201+06   .22130+05   .70709+01   .46328-03   .55286+07   .61612+02 3000.0000  5000.0000 1
1.  1 1.  6 1.  7 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CHN
  .31200+05   .35593+05   .13702+02   .35324-03  -.22896+07   .75862+02  500.0000  3000.0000 1
  .31200+05   .35593+05   .17889+02  -.35505-03  -.18367+08   .75862+02 3000.0000  5000.0000 1
1.  1 1.  6 1.  8 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CHO
 -.29000+04   .32367+05   .12893+02   .30064-03  -.20172+07   .78983+02  500.0000  3000.0000 1
 -.29000+04   .32367+05   .10303+02   .63331-03   .12162+08   .78983+02 3000.0000  5000.0000 1
1.  6 2.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            CC
 -.94054+05   .36535+05   .14456+02   .21039-03  -.18239+07   .79848+02  500.0000  3000.0000 1
 -.94054+05   .36535+05   .15645+02  -.38156-04  -.60277+07   .79848+02 3000.0000  5000.0000 1
2.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 9/61                             C2
  .19900+06   .24699+05   .77661+01   .69608-03   .18565+06   .68552+02  500.0000  3000.0000 1
  .19900+06   .24699+05   .10416+02   .56684-04  -.64020+07   .68552+02 3000.0000  5000.0000 1
2.  1 2.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            C2H2
  .54190+05   .48257+05   .18996+02   .76904-03  -.40904+07   .84969+02  500.0000  3000.0000 1
  .54190+05   .48257+05   .20395+02   .38906-03  -.64530+07   .84969+02 3000.0000  5000.0000 1
1.  1 1.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60                            HO
  .93300+04   .21404+05   .77319+01   .39439-03  -.97356+06   .61382+02  500.0000  3000.0000 1
  .93300+04   .21404+05   .96514+01  -.44353-04  -.68611+07   .61382+02 3000.0000  5000.0000 1
2.  1 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                            H2
```

```
    ,00000         ,21210+05    ,71196+01    ,62195-03  -,71269+06    ,48465+02  500,0000   3000,0000 1
    ,00000         ,21210+05    ,68179+01    ,58985-03   ,26511+07    ,48465+02 3000,0000   5000,0000 1
 2,  1 1,  3 0,  0 0,  0 0,  0 0,  0 0,  OJANAF 03/61                        H2O
  -,57798+05       ,30201+05    ,11225+02    ,81140-03  -,26080+07    ,48421+02  500,0000   3000,0000 1
  -,57798+05       ,30201+05    ,15728+02  -,19155-03  -,17360+08    ,48421+02 3000,0000   5000,0000 1
 1,  7 0,  0 0,  0 0,  0 0,  0 0,  0 0,  OJANAF 03/61                        N
    ,11296+06      ,13437+05    ,48694+01    ,38352-04   ,95846+05    ,48090+02  500,0000   3000,0000 1
    ,11296+06      ,13437+05    ,42896+01    ,24084-03  -,41727+06    ,48090+02 3000,0000   5000,0000 1
 .   7 1,  8 0,  0 0,  0 0,  0 C,  0 0,  OJANAF 06/63                        NO
    ,21580+05      ,22700+05    ,57762+01    ,89903-04  -,78966+06    ,68849+02  500,0000   3000,0000 1
    ,21580+05      ,22700+05    ,91629+01    ,65788-05  -,21252+07    ,68849+02 3000,0000   5000,0000 1
 1,  8 0,  0 0,  0 0,  0 0,  0 0,  0 0,  OJANAF 06/62                        O
    ,59559+05      ,13522+05    ,49723+01    ,38077-05   ,15475+05    ,50096+02  500,0000   3000,0000 1
    ,59559+05      ,13522+05    ,65749+01  -,22427-03  -,89178+07    ,50096+02 3000,0000   5000,0000 1
 2,  8 0,  0 0,  0 0,  0 0,  0 0,  0 0,  OJANAF 03/61                        O2
    ,00000         ,23446+05    ,80437+01    ,51087-03  -,15272+06    ,67973+02  500,0000   3000,0000 1
    ,00000         ,23446+05    ,10307+02    ,29099-04  -,78308+07    ,67973+02 3000,0000   5000,0000 1
 -,  99 0,  0 0,  0 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             E-
  -,00000          ,14901+05    ,49885+01  -,27280-05  -,13590+06    ,16456+02 2000,0000  10000,0000 1
  -,00000          ,14901+05    ,49885+01  -,27280-05  -,13590+06    ,16456+02 2000,0000  10000,0000 1
 .   6-1, 99 0,  0 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             C+
    ,42899+06      ,15012+05    ,48966+01    ,18070-04   ,34000+05    ,48423+02 2000,0000  10000,0000 1
    ,42899+06      ,15012+05    ,48966+01    ,18070-04   ,34000+05    ,48423+02 2000,0000  10000,0000 1
 1,  7-1, 99 0,  0 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             N+
    ,44664+06      ,15131+05    ,50175+01    ,61710-04  -,18410+07    ,49685+02 2000,0000  10000,0000 1
    ,44664+06      ,15131+05    ,50175+01    ,61710-04  -,18410+07    ,49685+02 2000,0000  10000,0000 1
 4,  8 1, 99 0,  0 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             O2-
  -,20525+05       ,26757+05    ,11148+02  -,65670-04  -,77910+07    ,69915+02 2000,0000  10000,0000 1
  -,20525+05       ,26757+05    ,11143+02  -,65670-04  -,77910+07    ,69915+02 2000,0000  10000,0000 1
 1,  6 1,  8-1, 99 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             CO+
    ,29428+06      ,24383+05    ,89362+01    ,37800-04  -,15090+07    ,66659+02 2000,0000  10000,0000 1
    ,29428+06      ,24383+05    ,89362+01    ,37800-04  -,15090+07    ,66659+02 2000,0000  10000,0000 1
 -,  7 1,  8-1, 99 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             NO+
       292+06      ,24197+05    ,91022+01    ,27740-04  -,31660+07    ,65438+02 2000,0000  10000,0000 1
     , 292+06      ,24197+05    ,91022+01    ,27740-04  -,31660+07    ,65438+02 2000,0000  10000,0000 1
 -,  8-1, 99 0,  0 0,  0 0,  0 0,  0 0,  OCONVAIR ZPH-122 12/61             O+
    ,37200+06      ,14929+05    ,33627+01    ,30671-03   ,59020+07    ,48485+02 2000,0000  10000,0000 1
    ,37200+06      ,14929+05    ,33627+01    ,30671-03   ,59020+07    ,48485+02 2000,0000  10000,0000 1


  ELEMENT  HYDROGEN     CARBON       NITROGEN     OXYGEN       ELECTRON
  BASE SP     H            C3           N2           CO           E-


MOLECULAR TRANSPORT PROPERTIES
  VISCOSITY ....., BUDDENBERG - WILKE MIXTURE FORMULA WITH MJ(I) CALCULATED ON
                THE BASIS OF D(I,I) = DBAR/G(I)**2

  THERMAL CONDUCTIVITY ....., MASON - SAXENA MIXTURE FORMULA WITH EUCKEN CORRECTION

  DIFFUSION COEFFICIENTS ....., D(I,J) = DBAR/(F(I)*F(J)) WITH DBAR BASED ON
                SIGMA =   3,4670, EPOVRK =  106,7000, AND MREF =  32,0000

   METHODS EMPLOYED

   0 CONDENSED PHASE, VALUES FOR F(I) AND G(I) SET EQUAL TO 1,E+10
```

```
1 VALUES FOR F(I) (OR G(I)) INPUT DIRECTLY

2 VALUES FOR F(I) (OR G(I)) CALCULATED BY  F(I) =(M(I)/FITMOL)**FFA AND
  G(I) = (M(I)/FITGMW)**GGA WHERE M(I) IS SPECIES MOLECULAR WEIGHT;
  FITMOL =  23.4000, AND FFA =  .4310, FITGMW =  24.3000, AND GGA =  .4940

3 VALUES FOR G(I) CALCULATED BY G(I) = SQRT(DBAR/D(I,I)) = (SIGMA(I)/SIGMA)
  * (EPS(I)/EPOVRK) **0.0795 * (M(I)/MREF) **0.25 WHERE SIGMA(I  AND EPS(I)
  ARE GIVEN WITH THERMODYNAMIC DATA

SPECIES   F(I) METHOD G(I) METHOD        SPECIES   F(I) METHOD G(I) METHOD
C3        1.204   2   1.196   2          CO        1.081   2   1.067   2
H          .258   2    .236   2          N2        1.081   2   1.067   2
E-         .010   2    .008   2          C+        *****   0   *****   0
C          .750   2    .726   2          CH4        .850   2    .828   2
CN        1.047   2   1.032   2          CH         .777   2    .753   2
CHN       1.064   2   1.049   2          CHO       1.097   2   1.084   2
CO2       1.313   2   1.310   2          C2        1.011   2    .995   2
C2H2      1.047   2   1.032   2          HO         .872   2    .850   2
H2         .348   2    .323   2          H2O        .895   2    .873   2
N          .802   2    .779   2          NO        1.113   2   1.101   2
O          .849   2    .827   2          O2        1.144   2   1.133   2
C+         .750   2    .726   2          N+         .802   2    .779   2
O2+       1.144   2   1.133   2          CO+       1.081   2   1.067   2
NO+       1.113   2   1.101   2          O+         .849   2    .827   2

STAGNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE EXPANSION

     CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
     .34796-00   .57994+01  -.20950+01   .89349-01   .11036+01

   TEMP = 5011.7898 DEG-K      PRES =   .0011 ATM      MOL WT = 17.9129670
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000       .00000       .00000
     ENTHALPY =   .3555556+04 CAL/GM     ENTROPY =   .39689+01 CAL/GM-DEG K
      DENSITY =   .305317-05 LB/CUFT
VEL =    .000    FT/SEC   MACH =  -.000       AREA =   .000    SQFT/LB/SEC

SPECIES   MOLE FR.       SPECIES   MOLE FR.       SPECIES   MOLE FR.
C3        .00000         CO        .00000         H         .00000
N2        .24104-00      E-        .18839-03      C+        .00000
C         .00000         CH4       .00000         CN        .00000
CH        .00000         CHN       .00000         CHO       .00000
CO2       .00000         C2        .00000         C2H2      .00000
HO        .00000         H2        .00000         H2O       .00000
N         .49567-00      NO        .31112-03      O         .26260-00
O2        .15519-05      C+        .00000         N+        .14435-04
O2-       .43191-14      CO+       .00000         NO+       .16078-03
O+        .13173-04


     CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
     .33275-00   .58414+01  -.19670+01   .69385-01   .10863+01

   TEMP = 4116.4436 DEG-K      PRES =   .0000 ATM      MOL WT = 20.1201180
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000       .00000       .00000
     ENTHALPY =   .3824303+04 CAL/GM     ENTROPY =   .39689+01 CAL/GM-DEG K
```

DENSITY = .109341-06 LB/CUFT
VEL = .125+05 FT/SEC MACH = .280+01 AREA = .732+03 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.39413-00	E-	.63069-04	C+	.00000
C	.00000	CH4	.00000	CN	.00000
CH	.00000	CHN	.00000	CHO	.00000
CO2	.00000	C2	.00000	C2H2	.00000
HO	.00000	H2	.00000	H2O	.00000
N	.31029-00	NO	.17564-03	O	.29527-00
O2	.75221-06	C+	.00000	N+	.42452-06
O2-	.42940-16	CO+	.00000	NO+	.61527-04
O+	.11144-05				

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.33177-00	.57422+01	-.19208+01	.66788-01	.10894+01

TEMP = 4058.1013 DEG-K PRES = .0000 ATM MOL WT = 20.2936430
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .3705578+04 CAL/GM ENTROPY = .39689+01 CAL/GM-DEG K
DENSITY = .833025-07 LB/CUFT
VEL = .129+05 FT/SEC MACH = .293+01 AREA = .930+03 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.40617-00	E-	.57977-04	C+	.00000
C	.00000	CH4	.00000	CN	.00000
CH	.00000	CHN	.00000	CHO	.00000
CO2	.00000	C2	.00000	C2H2	.00000
HO	.00000	H2	.00000	H2O	.00000
N	.29571-00	NO	.16699-03	O	.29784-00
O2	.71238-06	C+	.00000	N+	.31200-06
O2-	.29553-16	CO+	.00000	NO+	.86364-04
O+	.90161-06				

DISTANCE,FT	,83330-00	,13333+01
ROKAP	,14900-00	,21870-00
XI,(LB/SEC)**2	,14479-08	,26131-08
PRESSURE RATIO	,26200-01	,19500-01
STATIC PRESSURE,ATM	,29423-04	,21898-04
EDGE VELOCITY,FT/SEC	,12490+05	,12911+05
BETA	,11240+00	,11664+00
INCIDENT RADIATION FLUX	,00000	,00000
ENTROPY DROP,BTU/LB R	,00000	,00000
-1/FLUX NORM,PARAMETER	-,46146+04	-,54085+04

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330-00FEET - - -, 09 OCT ' '3:90:29

AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM
PAGE 4

----OUTPUT----

- - - - - - - - - - - - - - .0000 SECONDS - - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
1	3	0	1.7880	.00	.00	.0002	.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00000	.00000	.000000	.000000	.000000	.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	.0000000/ .0000000	.0000000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.000	.000	.000	.000	.000
TOTAL	.000	.000	.000	.000	.000

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	.000	.000	.000	.000	.000
TOTAL	.000	.000	.000	.000	.000

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	530.00	91.300	-378.21	9	1	530.00	91.300	-378.21
2	1	530.00	91.300	-378.21	10	1	530.00	91.300	-378.21
3	1	530.00	91.300	-378.21	11	1	530.00	91.300	-378.21
4	1	530.00	91.300	-378.21	12	1	530.00	91.300	-378.21
5	1	530.00	91.300	-378.21	13	1	530.00	91.300	-378.21
6	1	530.00	91.300	-378.21	14	1	530.00	91.300	-378.21
7	1	530.00	91.300	-378.21	15	1	530.00	91.300	-378.21
8	1	530.00	91.300	-378.21					

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13150127

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
1	4.112	1.934	.6147	.0910	4.+00	5	2.5+00	2	1.9+04	2	-8.2-05	2	5.1-05	4	-9.8-11	0
2	5.607	1.794	.5249	.2141	4.+00	5	2.3+00	2	1.8+04	2	1.1-05	2	-1.3-05	2	-3.1-09	0
3	6.960	1.625	.4012	.3315	3.+00	5	1.8+00	2	1.5+04	2	-4.6-06	2	-1.5-04	2	1.1-09	0
4	8.498	1.407	.2228	.6441	2.+00	5	1.2+00	2	1.0+04	2	1.2-04	2	-1.1-05	2	-4.7-10	0
5	9.960	1.248	.16731	.0000	7.-01	10	-3.8-01	2	5.5+03	2	-8.5-05	2	6.8-05	2	8.3-10	0
6	11.376	1.212	.16631	.0000	2.-07	6	1.4-02	2	-3.6+03	2	-8.2-05	2	1.4-04	2	-4.9-10	0
7	12.590	1.218	.16651	.0000	2.-07	7	7.6-03	4	7.8+01	2	2.9-05	2	6.1-04	3	-2.4-10	0
8	13.640	1.217	.16651	.0000	1.-07	6	5.1-04	3	2.5+00	2	2.3-04	2	-3.9-04	4	2.5-10	0
9	14.656	1.217	.16651	.0000	6.-08	6	1.4-05	2	-1.3+00	2	-1.9-04	2	2.4-06	3	7.4-10	0
10	15.651	1.217	.16651	.0000	6.-08	5	1.0-05	2	2.0-01	2	-4.5-05	2	-4.9-04	3	-1.4-09	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR- MALIZING PARAMETER	HEAT FLUXES (BTU/SEC SQ FT) DIFFUSIONAL	TOT ENTH	RERAD	QCOND
1.217+00	1.448-09	1.490-01	2.942-05	1.249+04	1.124-01	2.187-04	1.371+00	1.371+00	0.000	1.371+00

WALL SHEAR (LB/SQ FT)	MASS FLUXES (LB/SEC SQ FT) MECH REM	PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
5.241-02	0.000	0.000	0.000	0.000	1.422-14	-5.469-08	1.154-07	-6.068-08

MOM TRANS COEFF. RHOE*UE*CF/2	HEAT TRANS COEFF. RHOE*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS. RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.350-04	1.381-04	0.000	0.000	0.000	-0.000	9.348-01	-4.475-02	-2.357-02

MOMENTUM THICKNESS. THETA (FT)	DISPLACE. THICKNESS. DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS. LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.401-01	1.140-01	1.140-01	1.774-01	2.383+01	-0.000	-9.284-02	8.179-01	6.038-01

NODAL INFORMATION

DISTANCE. FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH- HALPY.G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	1.665-01	5.241-02	7.125+01	1.795+03	1.089+03	7.125+01	5.300+02	9.969+06
3.308-03	2.435-01	6.084-03	5.471-02	2.829-01	5.220-02	5.405+02	2.060+03	1.538+03	5.312+02	2.529+03	4.564+06
4.656-02	7.304-01	6.883-02	2.083-01	3.480-01	5.041-02	1.726+03	2.809+03	1.077+03	1.591+03	3.934+03	3.659+06
1.492-01	1.461+00	3.182-01	4.805-01	3.972-01	4.347-02	4.065+03	3.596+03	-6.537+02	3.346+03	6.020+03	2.958+06
3.589-01	2.435+00	9.526-01	8.000-01	2.590-01	2.418-02	7.257+03	2.989+03	-1.860+03	5.263+03	7.074+03	2.729+06
6.610-01	3.652+00	2.063+00	9.778-01	3.309-02	2.849-03	9.481+03	6.947+02	-3.955+02	6.502+03	7.345+03	2.678+06
1.302+00	6.087+00	4.494+00	1.000+00	-1.485-02	-1.249-03	1.000+04	-2.681+02	-2.969+02	4.885+03	7.413+03	2.666+06

DISTANCE FROM WALL (FT)	DENSITY. RHO (LB/CU FT)	VISCOSITY. MU LB/SEC FT	RHO*MU /RHOE*MUE. C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	2.194-06	1.069-05	3.743+00	-4.291-02	-4.323-07	1.001+00	7.443-01	2.886+31	0.000	0.000
3.308-03	4.597-07	2.994-05	2.197+00	2.895-01	1.230-05	7.046-01	7.543-01	2.886+01	0.000	2.866-01
4.656-02	2.730-07	3.952-05	1.722+00	3.060-01	1.712-05	7.062-01	7.423-01	2.666+01	0.000	9.182-01
1.492-01	1.582-07	5.151-05	1.301+00	3.174-01	2.310-05	7.054-01	7.431-01	2.365+01	0.000	1.555+00
3.589-01	1.236-07	5.627-05	1.110+00	3.264-01	2.610-05	7.037-01	7.386-01	2.170+01	0.000	2.377+00
6.610-01	1.123-07	5.711-05	1.023+00	3.313-01	2.696-05	7.016-01	7.372-01	2.047+01	0.000	2.774+00
1.302+00	1.093-07	5.731-05	1.000+00	3.328-01	2.721-05	7.008-01	7.371-01	2.012+01	0.000	2.799+00

	DISTANCE FROM WALL, FT						
	0.000	3.308-03	4.656-02	1.492-01	3.589-01	6.610-01	1.302+00

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01
	1.446-05	-1.099-06	-1.045-06	-1.276-06	-1.050-06	-2.971-07	1.088-07
	-6.389-05	1.109-07	-3.170-07	2.318-07	6.139-07	1.667-07	0.000
CO	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01
	2.431-05	9.651-07	4.260-07	4.508-07	3.903-07	8.428-08	-3.517-08
	-9.590-05	-1.107-06	3.402-08	-6.211-08	-2.514-07	-4.906-08	0.000
H	0.000	1.471-11	-4.981-11	-1.093-10	-1.988-11	1.059-12	0.000
	6.573-11	5.510-11	-3.201-10	1.572-10	2.649-11	7.909-12	-8.779-12
	-4.369-11	-7.705-10	6.534-10	-1.342-10	-1.526-11	-6.855-12	0.000
N2	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-3.877-03	1.335-07	6.190-07	8.252-07	6.600-07	2.128-07	-7.363-08
	1.598-04	9.971-07	2.824-07	-1.696-07	-3.674-07	-1.176-07	-0.000

MOLE FRACTIONS

C3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N2	7.881-01	7.876-01	7.233-01	6.378-01	5.034-01	4.187-01	3.941-01
E-	0.000	0.000	2.054-09	5.117-06	3.932-05	5.779-05	6.308-05
C-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	1.000-30	7.390-13	1.627-06	1.498-02	1.770-01	2.806-01	3.104-01
NO	1.300-16	8.139-04	9.142-03	8.174-04	2.712-04	1.928-04	1.756-04
O	1.000-30	8.599-05	1.526-01	3.464-01	3.184-01	3.005-01	2.993-01
O2	2.119-01	2.115-01	1.149-01	3.349-05	1.798-06	8.950-07	7.519-07
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N+	0.000	0.000	2.531-24	1.142-11	4.873-08	2.804-07	4.249-07
O2+	0.000	0.000	6.703-15	4.202-16	7.930-17	4.881-17	4.293-17
CO+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NO+	0.000	0.000	2.054-09	5.115-06	3.900-05	5.646-05	6.154-05
O+	0.000	0.000	6.739-18	1.343-09	2.732-07	8.489-07	1.115-06

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TIME   ,70000+01 SECONDS - - - - - - - - - - - - - - - - - - - - - - - - - -  09 OCT 69 13:50:43

    CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
     ,34958-00   ,42177+01  -,17757+01   ,88824-01   ,11234+01

   TEMP = 5915,9953 DEG-K      PRES =    ,0509 ATM      MOL WT = 18,2659570
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      ,00000       -,00000      -,00000
    ENTHALPY =     ,5622222+04 CAL/GM     ENTROPY =    ,35620+01 CAL/GM-DEG K
    DENSITY =     ,119547-03 LB/CUFT
VEL =     ,000     FT/SEC    MACH =  -,000       AREA =    ,000     SQFT/LB/SEC

SPECIES    MOLE FR,          SPECIES    MOLE FR,          SPECIES    MOLE FR,
C3          ,00000           CO          ,00000           H           ,00000
N2          ,26469-00        E-          ,35584-03        C+          ,00000
C           ,00000           CH4         ,00000           CN          ,00000
CH          ,00000           CHN         ,00000           CHO         ,00000
CO2         ,00000           C2          ,00000           C2H2        ,00000
HO          ,00000           H2          ,00000           H2O         ,00000
N           ,46664-00        NO          ,11861-02        O           ,26676-00
O2          ,10951-04        O+          ,00000           N+          ,41249-04
O2-         ,13424-11        CO+         ,00000           NO+         ,28494-03
O+          ,29252-04


    CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
     ,33251-00   ,39520+01  -,15053+01   ,60074-01   ,11015+01

   TEMP = 4669,4936 DEG-K      PRES =    ,0013 ATM      MOL WT = 20,7339790
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      ,00000       -,00000      -,00000
    ENTHALPY =     ,3667643+04 CAL/GM     ENTROPY =    ,35620+01 CAL/GM-DEG K
    DENSITY =     ,480442-05 LB/CUFT
VEL =     ,133+05 FT/SEC    MACH =     ,282+01       AREA =    ,167+02 SQFT/LB/SEC

SPECIES    MOLE FR,          SPECIES    MOLE FR,          SPECIES    MOLE FR,
C3          ,00000           CO          ,00000           H           ,00000
N2          ,43613-00        E-          ,10250-03        C+          ,00000
C           ,00000           CH4         ,00000           CN          ,00000
CH          ,00000           CHN         ,00000           CHO         ,00000
CO2         ,00000           C2          ,00000           C2H2        ,00000
HO          ,00000           H2          ,00000           H2O         ,00000
N           ,25924-00        NO          ,71241-03        O           ,30370-00
O2          ,61065-05        C+          ,00000           N+          ,82988-06
O2-         ,14781-13        CO+         ,00000           NO+         ,99710-04
O+          ,19632-05


    CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
     ,33152-00   ,38436+01  -,14488+01   ,56632-01   ,11005+01

   TEMP = 4586,6417 DEG-K      PRES =    ,0010 ATM      MOL WT = 20,9252690
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      ,00000       -,00000      -,00000
    ENTHALPY =     ,3537262+04 CAL/GM     ENTROPY =    ,35620+01 CAL/GM-DEG K
    DENSITY =     ,344457-05 LB/CUFT
VEL =     ,137+05 FT/SEC    MACH =     ,295+01       AREA =    ,212+02 SQFT/LB/SEC

SPECIES    MOLE FR,          SPECIES    MOLE FR,          SPECIES    MOLE FR,
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C3	,00000	CO	,00000	H	,00000
N2	,44942-00	E-	,92191-04	C+	,00000
C	,00000	CH4	,00000	CN	,00000
CH	,00060	CHN	,00000	CHO	,00000
CO2	,00000	C2	,00000	C2H2	,00000
HO	,00000	H2	,00000	H2O	,00000
N	,24316-00	NO	,68173-03	O	,30655-00
O2	,58860-05	C+	,00000	N+	,57888-06
O2-	,10298-13	CO+	,00000	NO+	,90076-04
O+	,15370-03				

DISTANCE,FT	,83330-00	,13333+01
ROKAP	,14900-00	,21870-00
XI,(LB/SEC)**2	,69161-07	,12483-06
PRESSURE RATIO	,26200-01	,19500-01
STATIC PRESSURE,ATM	,13336-02	,99255-03
EDGE VELOCITY,FT/SEC	,13271+05	,13707+05
BETA	,10938-00	,11352+00
INCIDENT RADIATION FLUX	,00000	,00000
ENTROPY DROP,BTU/LB R	,00000	,00000
*1/FLUX NORM,PARAMETER	-,66769+03	-,78186+03

TIME .70000+01 SECONDS - - - STREAMWISE DIMENSION .83330-00FEET - - -, 09 OCT 69 13150143

TIME ,70000+01 SECONDS - - - STREAMWISE DIMENSION ,83330-00 FEET - - -09 OCT 69 13:50144

ITERATED VALUES — DAMP — MAX.LIN — MAX.ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	2,351	1,220	.1632	,4999	1,-07	6	1,3-02	3	1,1+02	2	4,6-05	2	1,2-03	3	1.2-09	0
2	3,408	1,227	.1603	1,0000	1,-07	6	6,6-03	2	8,7+02	2	-4,5-05	2	9,0-05	4	-6,0-10	0
3	4,317	1,229	.1608	1,0000	1,-07	5	-2,1-03	2	4,4+02	2	1,5-04	2	-5,4-04	2	3,9-10	0
4	5,622	1,228	.1608	1,0000	1,-07	6	8,0-04	3	8,7+00	2	-1,1-04	2	3,3-04	2	2.5-11	0
5	6,834	1,228	.1608	1,0000	6,-08	8	1,0-05	2	3,7-01	2	1,1-05	2	-2,7-05	7	-1.7-11	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1,228+00	6,916-08	1,490-01	1,334-03	1,327+04	1,094-01	1,498-03	9,606+00	9,606+00	0.000	9,605+00

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM	PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3,823-01	0,000	0,000	0,000	0,000	-2,853-14	2,034-09	2,883-08	-3,086-08

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFF.CIENTS. RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
9,268-04	9,561-04	0,000	0,000	0,000	-0,000	2,873+00	6,717-03	7.186-03

MOMENTUM THICKNESS, THETA (FT)	DISPLACE, THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE, (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2,221-02	1,641-02	1,641-02	2,799-02	9,559+02	-0,000	8,623+01	-3,479-02	-1,998-02

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0,000	0,000	0.000	1,608-01	3,823-01	7,315+01	1,451+03	2,366+03	7,315+01	5.000+02	4.652+08
8,421-04	2,457-01	5,982-03	5,330-02	2,731-01	3,809-01	5,010+02	2,032+03	1.685+03	4,921+02	2.392+03	2.127+08
7,293-03	7,371-01	6,812-02	2,057-01	3,471-01	3,680-01	1,703+03	2,860+03	1,031+03	1,554+03	4,307+03	1,569+08
2,267-02	1,474+00	3,182-01	4,787-01	3,938-01	3,190-01	4,091+03	3,620+03	-6,028+02	3,285+03	6.202+03	1,321+08
5,536-02	2,457+00	9,573-01	8,000-01	2,601-01	1,777-01	7,397+03	3,028+03	-1,924+03	5,106+03	7,931+03	1.168+08
1,035-01	3,685+00	2,079+00	9,790-01	3,132-02	1,978-02	9,625+03	6,647+02	-3,772+02	6,294+03	8,313+03	1.141+08
2,057-01	6,142+00	4,533+00	1,000+00	-1,419-02	-8,766-05	1,012+04	-2,621+02	-2,[illegible]1+02	6,603+03	8.409+03	1.135+08

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	1,054-04	1,029-05	3,850+00	-8,500-02	-1,00[illegible]-06	8,709-01	7,443-01	2,886+01	0.000	0.000
8,421-04	2,203-05	2,887-05	2,257+00	2,872-01	1,177-05	7,044-01	7,443-01	2,886+01	0.000	3.042-01
7,293-03	1,133-05	4,267-05	1,716+00	3,079-01	1,859-05	7,069-01	7,424-01	2,728+01	0.000	9.108-01
2,267-02	7,021-06	5,261-05	1,311+00	3,179-01	2,370-05	7,056-01	7,434-01	2,384+01	0,000	1,571+00
5,536-02	3,113-06	6,094-05	1,106+00	3,265-01	2,825-05	7,042-01	7,399-01	2,221+01	0,000	2,393+00
1,035-01	4,627-06	6,225-05	1,022+00	3,311-01	2,934-05	7,023-01	7,377-01	2,106+01	0,000	2,793+00
2,057-01	4,504-06	6,254-05	9,999-01	3,325-01	2,964-05	7,017-01	7,374-01	2,073+01	0,000	2,816+00

DISTANCE FROM WALL,FT

0,000	8,421-04	7,293-03	2,267-02	5,536-02	1,035-01	2,057-01

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01
	8.220-06	1.137-08	7.406-07	7.868-07	6.883-07	2.281-07	-8.513-08
	-3.341-05	1.484-06	6.264-08	-1.002-09	-3.746-07	-1.275-07	0.000
CO	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01
	-6.061-05	1.577-06	-2.434-07	-1.133-07	-2.316-07	-1.140-07	4.801-08
	2.531-04	-3.704-06	1.765-07	-1.204-07	9.576-08	6.594-08	0.000
H	0.000	-3.798-12	6.000-12	2.102-11	6.317-12	3.709-12	0.000
	-4.426-12	-2.650-11	6.638-11	-2.346-11	-8.084-12	3.838-12	-6.898-12
	-8.982-11	1.890-10	-1.219-10	1.564-11	5.705-12	-4.383-12	0.000
N2	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	9.239-05	-1.508-06	-4.973-07	-6.735-07	-4.866-07	-1.141-07	3.712-08
	-2.197-04	2.220-06	-2.390-07	2.206-07	2.788-07	6.196-08	-0.000

MOLE FRACTIONS

C3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N2	7.861-01	7.878-01	7.365-01	6.449-01	5.379-01	4.590-01	4.361-01
E-	0.000	0.000	6.330-09	2.992-06	5.907-05	9.292-05	1.025-04
C-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	1.000-30	1.058-14	3.999-06	3.720-03	1.399-01	2.316-01	2.593-01
NO	1.588-17	5.229-04	1.702-02	4.613-03	1.101-03	7.792-04	7.123-04
O	1.000-30	3.688-06	1.092-01	3.439-01	3.290-01	3.085-01	3.037-01
O2	2.119-01	2.117-01	1.372-01	8.712-04	1.947-05	7.294-06	6.104-06
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N+	0.000	0.000	1.987-22	5.048-13	7.512-08	5.343-07	8.308-07
O2-	0.000	0.000	5.536-13	2.496-13	2.777-14	1.677-14	1.470-14
CO+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NO+	0.000	0.000	6.331-09	2.991-06	5.860-05	9.091-05	9.973-05
O+	0.000	0.000	9.208-17	2.159-10	4.169-07	1.479-06	1.965-06

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13:50:50

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
1	8.457	1.226	.1622	.4999	1.-07	6	-1.3-02	3	-1.0+02	2	-1.3-05	2	-1.9-04	4	3.1-10	0
2	9.516	1.223	.1636	1.0000	1.-07	6	-6.5-03	3	-9.2+01	2	4.0-05	2	-2.2-04	4	4.0-10	0
3	10.561	1.223	.1636	1.0000	1.-07	9	-1.3-04	5	1.7+00	2	5.2-06	2	2.3-04	4	-8.3-10	0
4	11.552	1.223	.1636	1.0000	1.-07	6	1.7-05	2	4.6-01	2	-1.4-04	2	-4.6-05	4	1.3-09	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.223+00	1.448-09	1.490-01	2.942-05	1.249+04	1.124-01	2.167-04	1.379+00	1.379+00	0.000	1.380+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
5.255-02	0.000	0.000	0.000	0.000	-6.958-14	-3.376-08	3.995-08	-6.194-09

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.354-04	2.390-04	0.000	0.000	0.000	-0.000	-1.431+02	1.888-02	2.937-03

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.404-01	1.149-01	1.149-01	1.784-01	2.363+01	-0.000	1.915+03	-4.437-01	-2.230-01

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,H (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	1.636-01	5.255-02	7.315+01	1.452+03	2.363+03	7.315+01	5.000+02	1.026+07
5.836-03	2.446-01	6.031-03	5.397-02	2.777-01	5.233-02	4.989+02	2.030+03	1.585+03	4.898+02	2.388+03	4.697+06
4.819-02	7.337-01	6.838-02	2.066-01	3.462-01	5.049-02	1.681+03	2.805+03	1.084+03	1.548+03	3.913+03	3.649+06
1.501-01	1.467+00	3.177-01	4.791-01	3.968-01	4.358-02	4.031+03	3.600+03	-6.421+02	3.316+03	5.976+03	2.969+06
3.604-01	2.446+00	9.543-01	8.000-01	2.591-01	2.421-02	7.245+03	2.972+03	-1.866+03	5.251+03	7.071+03	2.720+06
6.638-01	3.669+00	2.070+00	9.782-01	3.239-02	2.789-03	9.484+03	6.898+02	-3.914+02	5.903+03	7.349+03	2.678+06
1.308+00	6.114+00	4.512+00	1.000+00	-1.460-02	-1.228-03	1.000+04	-2.676+02	-2.942+02	6.885+03	7.413+03	2.666+06

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	2.325-06	1.029-05	3.818+00	-8.530-02	-1.004-06	8.709-01	7.443-01	2.886+01	0.000	0.000
5.838-03	4.869-07	2.883-05	2.240+00	2.871-01	1.175-05	7.043-01	7.443-01	2.886+01	0.000	2.902-01
4.819-02	2.757-07	3.941-05	1.734+00	3.087-01	1.706-05	7.062-01	7.424-01	2.677+01	0.000	9.118-01
1.501-01	1.596-07	5.127-05	1.306+00	3.171-01	2.305-05	7.054-01	7.432-01	2.367+01	0.000	1.552+00
3.604-01	1.237-07	5.626-05	1.110+00	3.264-01	2.609-05	7.037-01	7.386-01	2.171+01	0.000	2.378+00
6.638-01	1.123-07	5.711-05	1.023+00	3.313-01	2.696-05	7.016-01	7.372-01	2.047+01	0.000	2.775+00
1.308+00	1.093-07	5.731-05	1.000+00	3.328-01	2.721-05	7.008-01	7.371-01	2.012+01	0.000	2.799+00

DISTANCE FROM WALL,FT

0.000	5.838-03	4.819-02	1.501-01	3.604-01	6.638-01	1.308+00

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1,764-01	-1,764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01
	2,571-05	-1,073-06	-3,630-07	-4,450-07	-3,864-07	-9,784-08	3,929-08
	-1,095-04	1,451-08	-1.117-07	5,983-08	2,360-07	5,442-08	0,000
CO	4.114-01	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01	4.114-01
	-3,642-05	1,201-06	6,430-08	2,860-08	1,906-07	2,438-08	-6,709-09
	1,538-04	-2,325-06	-4,866-08	1,656-07	-1,359-07	-1,271-08	0,000
H	0,000	-7 338-12	-8,979-11	-1,709-10	-8,797-11	-1,570-11	0,000
	-2,466-11	-3,535-11	-3,018-10	8,062-11	8,894-11	2,925-11	-1,641-11
	-4,373-11	-5,447-10	5,212-10	8,504-12	-4,881-11	-1,867-11	0,000
N2	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01
	1,071-05	-1,285-07	2,990-07	4,163-07	1,997-07	7,343-08	-2,053-08
	-4,433-05	8,740-07	1,598-07	-2,285-07	-1,000-07	-4,169-08	-0,000

MOLE FRACTIONS

C3	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N2	7,861-01	7,878-01	7,265-01	6,393-01	5,042-01	4,186-01	3,941-01
E-	0,000	0,000	1,786-09	4,608-06	3,914-05	5,780-05	6,308-05
C-	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CH4	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CN	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CH	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHN	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CO2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C2H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
HO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2O	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N	1,000-39	6,563-14	1,416-06	1,317-02	1,769-01	2,806-01	3,104-01
NO	1,588-17	5,149-04	9,110-03	8,563-04	2,721-04	1,928-04	1,796-04
O	1,000-39	2,378-05	1,446-01	3,447-01	3,186-01	3,005-01	2,953-01
O2	2,119-01	2,117-01	1,198-01	3,847-05	1,812-06	8,947-07	7,519-07
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N+	0,000	0,000	1,653-24	7,537-12	4,775-08	2,806-07	4,249-07
O2+	0,000	0,000	6,299-15	4,513-16	7,972-17	4,880-17	4,293-17
CO+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
NO+	0,000	0,000	1,786-09	4,607-06	3,882-05	5,667-05	6,154-05
O+	0,000	0,000	4,918-18	1,033-09	2,696-07	8,493-07	1,115-06

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13:50:55

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX,LIN ERROR	MAX,ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
1	13,290	1.101	.8698	,2210	1,-07	1	-5,0-02	1	-1,0+03	1	5,9-02	1	-7,8-03	1	4.7-03	0
2	16,381	1.135	,7063	,2010	2,-07	5	3,0+00	2	2,7+04	1	4,4-02	1	-6,2-03	1	3.4-03	0
3	18,636	1.170	,5587	,2420	1,-07	5	2,4+00	2	2,3+04	1	3,6-02	2	-6,2-03	1	2.8-03	0
4	20,549	1.205	,4253	,3066	2,-07	5	1,8+00	2	1,8+04	1	2,6-02	2	3,9-03	1	2.2-03	0
5	22,490	1.242	,3042	,4272	2,-07	5	1,3+00	2	1,3+04	1	2,0-02	2	-4,3-03	1	1.6-03	0
6	24,507	1.281	,1956	,7092	2,-07	5	7,5-01	2	7,4+03	1	1,2-02	1	-1,6-03	1	9.1-04	0
7	26,491	1.299	,15101	,0000	1,-07	5	2,2-01	2	2,3+03	1	3,5-03	2	1,4-03	1	2.8-04	0
8	28,224	1.298	,15081	,0000	2,-07	7	-4,5-03	3	5,9+01	3	-2,0-04	2	-1,0-03	3	-1.6-05	0
9	29,774	1.298	,15081	,0000	1,-07	7	-2,7-04	4	-1,7+01	2	3,2-04	2	1,1-03	2	1.6-05	0
10	31,216	1.298	,15081	,0000	6,-08	6	-2,5-05	4	-1,0+00	2	-5,4-04	2	-1,4-04	2	-2.1-05	0

ALPHA	XI (1/SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1,298+00	1,448-09	1,450-01	2,942-05	1,249+04	1,124-01	2,167-04	1,488+00	1,498+00	0,000	1.349+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
4,982-02	0,000	1,084-05	0,000	1,084-05	-6,501-07	-7,822-06	7,835-06	6,372-07

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1,283-04	1,363-04	7,950-02	0,000	7,950-02	1,392-04	1,405-04	1,409-04	1,390-04

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1,465-01	8,754-02	1,008-01	1,881-01	2,383+01	1,923-01	1,922-01	1,923-01	1,908-01

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTHALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0,000	-5,000-02	0,000	1,508-01	4,982-02	-9,182+02	1,317+03	3,113+03	-9,184+02	5.000+02	1.026+07
7,329-03	2,595-01	-4,375-02	5,270-02	2,554-01	4,978-02	-4,712+02	2,126+03	1,492+03	-4,801+02	2,343+03	4,742+06
4,918-02	7,785-01	2,089-02	2,019-01	3,197-01	4,858-02	8,333+02	2,901+03	8,402+02	7,060+02	3,660+03	3,794+06
1,386-01	1,557+00	2,804-01	4,719-01	3,738-01	4,314-02	3,346+03	3,555+03	-2,523+02	2,652+03	4,778+03	3,320+06
3,470-01	2,595+00	9,509-01	8,000-01	2,584-01	2,422-02	6,900+03	3,293+03	-2,012+03	4,906+03	6,989+03	2,745+06
6,683-01	3,893+00	2,141+00	9,834-01	2,430-02	2,089-03	9,479+03	6,820+02	-3,708+02	6,466+03	7,340+03	2,679+06
1,353+00	6,486+00	4,734+00	1,000+00	-1,153-02	-9,696-04	1,000+04	-2,802+02	-2,614+02	6,885+03	7,413+03	2,666+06

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	2,393-06	1,029-05	3,928+00	2,065-01	2,810-06	7,557-01	7,413-01	2,970+01	0,000	0.000
7,329-03	5,100-07	2,846-05	2,317+00	3,061-01	1,240-05	7,028-01	7,414-01	2,946+01	0,000	2,940-01
4,918-02	2,999-07	3,774-05	1,806+00	3,214-01	1,820-05	6,666-01	7,402-01	2,724+01	0,000	9,343-01
1,386-01	1,950-07	4,408-05	1,372+00	3,264-01	2,267-05	6,346-01	7,407-01	2,313+01	0,000	1,638+00
3,470-01	1,250-07	5,383-05	1,114+00	3,315-01	2,758-05	6,710-01	7,379-01	2,169+01	0,000	2,389+00
6,683-01	1.122-07	5,707-05	1,022+00	3,324-01	2,729-05	6,951-01	7,370-01	2,044+01	0,000	2,789+00
1,353+00	1,093-07	5,731-05	1,000+00	3,328-01	2,721-05	7,008-01	7,371-01	2,012+01	0,000	2,799+00

DISTANCE FROM WALL,FT

	0,000	7,329-03	4,918-02	1,386-01	3,470-01	6,683-01	1,353+00

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1,172-01	-1,197-01	-1,269-01	-1,405-01	-1,593-01	-1,730-01	-1,764-01
	-7,157-03	-1,212-02	-1,557-02	-1,950-02	-1,672-02	-4,331-03	1,704-03
	-1,914-02	-6,647-03	-5,047-03	2,684-03	9,547-03	2,326-03	0,000
CO	4,031-01	4,035-01	4,045-01	4,064-01	4,090-01	4,109-01	4,114-01
	9,630-04	1,692-03	2,276-03	2,725-03	2,339-03	6,090-04	-2,380-04
	2,808-03	9,324-04	7,096-04	-3,754-04	-1,334-03	-3,249-04	0,000
H	4,671-03	4,474-03	3,907-03	2,829-03	1,346-03	2,690-04	0,000
	-5,608-04	-9,565-04	-1,229-03	-1,539-03	-1,319-03	-3,417-04	1,344-04
	-1,525-03	-5,245-04	-3,981-04	2,117-04	7,532-04	1,835-04	0,000
N2	7,094-01	7,117-01	7,185-01	7,313-01	7,490-01	7,618-01	7,650-01
	6,755-03	1,139-02	1,463-02	1,832-02	1,570-02	4,068-03	-1,600-03
	1,786-02	6,239-03	4,739-03	-2,520-03	-8,966-03	-2,184-03	-0,000

MOLE FRACTIONS

C3	1,000-30	1,000-30	1,000-30	2,857-28	1,659-17	1,678-18	0,000
CO	1,000-30	1,700-05	5,637-02	6,471-02	2,879-02	5,296-03	0,000
H	1,000-30	4,553-07	2,942-02	6,446-02	2,807-02	5,454-03	0,000
N2	7,519-01	7,533-01	6,961-01	6,023-01	5,055-01	4,171-01	3,941-01
E-	0,000	0,000	2,215-10	1,115-07	3,226-05	5,696-05	6,308-05
C-	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C	1,000-30	3,409-32	9,628-17	6,601-11	1,774-04	1,630-04	0,000
CH4	1,000-30	1,779-33	1,720-23	1,279-26	2,679-32	1,000-30	0,000
CN	1,000-30	5,317-27	2,199-15	3,566-11	1,990-06	1,126-06	0,000
CH	1,000-30	1,000-30	2,113-19	2,305-15	1,598-11	1,611-12	0,000
CHN	1,000-30	2,088-22	6,482-14	1,159-12	1,124-11	5,304-13	0,000
CHO	1,000-30	1,413-16	3,981-10	1,601-10	4,679-12	1,322-13	0,000
CO2	1,376-01	1,316-01	4,521-02	2,165-04	5,390-08	4,682-09	0,000
C2	1,000-30	1,000-30	2,949-28	3,159-20	3,792-11	1,283-11	0,000
C2H2	1,000-30	1,000-30	1,212-24	2,710-24	1,763-22	4,489-25	0,000
HO	1,592-28	8,496-05	1,312-02	3,553-04	2,675-07	2,620-08	0,000
H2	1,000-30	4,835-06	6,232-03	5,432-05	1,404-08	2,663-10	0,000
H2O	6,880-02	6,577-02	2,529-02	1,178-06	2,356-13	2,010-15	0,000
N	1,000-30	2,778-14	2,205-07	1,596-04	1,486-01	2,773-01	3,104-01
NO	6,880-19	2,066-04	5,022-03	2,865-03	2,615-04	1,892-04	1,756-04
O	1,000-30	7,330-06	4,329-02	2,625-01	2,877-01	2,944-01	2,953-01
O2	4,167-02	4,895-02	7,593-02	2,340-03	1,780-06	8,679-07	7,519-07
C+	0,000	0,000	1,453-28	1,315-18	1,819-07	5,355-07	0,000
N+	0,000	0,000	8,152-27	6,267-18	2,845-08	2,730-07	4,249-07
O2-	0,000	0,000	7,756-16	2,237-15	6,818-17	4,660-17	4,293-17
CO+	0,000	0,000	4,098-20	2,397-14	2,435-08	2,126-08	0,000
NO+	0,000	0,000	2,215-10	1,115-07	3,185-05	5,531-05	6,154-05
O+	0,000	0,000	6,601-20	1,216-13	1,784-07	8,206-07	1,119-06

TIME .70000+01 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13:51:14

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR	MAX.ERRORS IN CONSERVATION EQS. MOMENTUM	ENERGY	C3	CO	H	
1	33.450	1.300	.1495	.4999	1.-07	6 1.3-02	5 -2.6+02	3 -5.9-04	2 -2.1-04	3 -4.7-05	0
2	35.175	1.303	.1482	1.0000	1.-07	6 7.3-03	5 -1.4+02	3 -3.3-04	2 -5.9-04	3 -2.6-05	0
3	36.680	1.303	.1482	1.0000	1.-07	7 -1.1-03	4 -9.1+00	2 -3.5-04	2 4.1-04	2 9.7-06	0
4	38.091	1.303	.1482	1.0000	1.-07	6 -5.7-05	4 -1.7+00	2 2.8-04	2 1.9-04	2 9.1-06	0
5	39.475	1.303	.1482	1.0000	1.-07	5 -6.9-06	2 -1.4+00	2 -1.4-04	2 -1.3-03	2 -1.0-05	0
6	40.896	1.303	.1482	1.0000	1.-07	6 -1.8-05	2 1.9+00	2 1.2-04	2 1.9-03	2 -3.5-05	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL (BTU/SEC SQ FT)	TOT ENTH	RERAD	QCOND
1.303+00	6.916-08	1.490-01	1.334-03	1.327+04	1.094-01	1.498-03	1.025+01	1.032+01	0.000	9.321+00

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM (LB/SEC SQ FT)	PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3.627-01	0.000	7.489-05	0.000	7.489-05	-4.514-06	-5.201-05	5.071-05	5.811-06

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CH (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
8.792-04	9.287-04	8.063-02	0.000	8.063-02	9.637-04	9.316-04	9.092-04	1.228-03

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2.318-02	1.243-02	1.452-02	2.925-02	9.559+02	3.024-02	3.023-02	3.020-02	3.066-02

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-5.000-02	0.000	1.482-01	3.627-01	-9.211+02	1.304+03	3.058+03	-9.209+02	5.000+02	4.652+08
1.052-03	2.606-01	-4.381-02	5.198-02	2.507-01	3.625-01	-4.775+02	2.101+03	1.567+03	-4.868+02	2.331+03	2.154+08
7.365-03	7.818-01	2.046-02	2.000-01	3.196-01	3.944-01	8.300+02	2.917+03	1.007+03	6.887+02	4.077+03	1.629+08
2.183-02	1.564+00	2.803-01	4.708-01	3.717-01	3.145-01	3.418+03	3.705+03	-3.899+02	2.639+03	5.202+03	1.442+08
5.351-02	2.606+00	9.527-01	8.000-01	2.599-01	1.777-01	7.068+03	3.298+03	-2.041+03	4.817+03	7.824+03	1.176+08
1.045-01	3.909+00	2.149+00	9.843-01	2.299-02	1.449-02	9.634+03	6.392+02	-3.473+02	6.226+03	8.307+03	1.141+08
2.130-01	6.515+00	4.753+00	1.000+00	-1.095-02	-6.765-03	1.012+04	-2.658+02	-2.620+02	6.603+03	8.405+03	1.135+08

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	1.085-04	1.029-05	3.961+00	-2.068-01	-2.815-06	7.596-01	7.413-01	2.970+01	0.000	0.000
1.052-03	2.323-05	2.837-05	2.340+00	3.099-01	1.235-05	7.028-01	7.413-01	2.966+01	0.000	3.086-01
7.365-03	1.245-05	4.062-05	1.795+00	3.241-01	1.933-05	6.812-01	7.402-01	2.779+01	0.000	9.368-01
2.183-02	8.262-06	4.670-05	1.370+00	3.274-01	2.400-05	6.372-01	7.403-01	2.354+01	0.000	1.737+00
5.351-02	5.162-06	6.037-05	1.106+00	3.317-01	2.984-05	6.710-01	7.387-01	2.212+01	0.000	2.401+00
1.045-01	4.621-06	6.220-05	1.020+00	3.322-01	2.969-05	6.958-01	7.375-01	2.103+01	0.000	2.807+00
2.130-01	4.504-06	6.254-05	9.999-01	3.325-01	2.964-05	7.017-01	7.374-01	2.073+01	0.000	2.816+00

DISTANCE FROM WALL,FT

0.000	1.092-03	7.365-03	2.183-02	5.351-02	1.045-01	2.130-01

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1.170-01	-1.195-01	-1.267-01	-1.405-01	-1.594-01	-1.731-01	-1.764-01
	-7.123-03	-1.200-02	-1.567-02	-1.951-02	-1.679-02	-4.219-03	1.672-03
	-1.871-02	-7.041-03	-4.919-03	2.616-03	9.646-03	2.260-03	0.000
CO	4.031-01	4.035-01	4.045-01	4.064-01	4.090-01	4.109-01	4.114-01
	9.307-04	1.676-03	2.189-03	2.726-03	2.345-03	5.893-04	-2.339-04
	2.860-03	9.839-04	6.872-04	-3.655-04	-1.348-03	-3.158-04	0.000
H	4.684-03	4.488-03	3.919-03	2.834-03	1.341-03	2.618-04	0.000
	-5.358-04	-9.466-04	-1.236-03	-1.540-03	-1.324-03	-3.326-04	1.319-04
	-1.500-03	-5.556-04	-3.881-04	2.064-04	7.610-04	1.783-04	0.000
N2	7.092-01	7.116-01	7.183-01	7.313-01	7.490-01	7.619-01	7.650-01
	6.748-03	1.127-02	1.472-02	1.833-02	1.577-02	3.962-03	-1.570-03
	1.735-02	6.613-03	4.620-03	-2.457-03	-9.060-03	-2.123-03	-0.000

MOLE FRACTIONS

C3	1.000-30	1.000-30	7.479-34	1.023-26	2.160-16	2.618-17	0.000
CO	1.000-30	2.250-06	5.166-02	6.493-02	2.928-02	9.304-03	0.000
H	1.000-30	2.246-08	1.630-02	6.295-02	2.944-02	5.462-03	0.000
N2	7.518-01	7.533-01	7.083-01	6.096-01	5.343-01	4.969-01	4.361-01
E-	0.000	0.000	7.368-10	1.732-07	4.818-05	9.139-05	1.025-04
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	1.000-30	4.672-34	2.097-15	9.219-11	1.493-04	1.846-04	0.000
CH4	1.000-30	1.290-33	4.900-21	1.162-22	3.388-28	2.592-32	0.000
CN	1.000-30	5.509-28	6.411-14	1.267-10	4.883-06	3.077-06	0.000
CH	1.000-30	4.980-36	1.324-17	3.773-14	1.857-10	1.980-11	0.000
CHN	1.000-30	6.160-23	1.714-12	2.391-11	2.069-10	9.998-12	0.000
CHO	1.000-30	4.426-17	4.122-09	4.314-09	1.398-10	3.773-12	0.000
CO2	1.380-01	1.321-01	9.641-02	1.248-03	4.459-07	3.593-08	0.000
C2	1.000-30	1.000-30	1.569-25	2.067-19	1.603-10	6.435-11	0.000
C2H2	1.000-30	1.000-30	6.694-24	9.939-22	4.954-20	1.267-22	0.000
HO	6.126-29	3.046-05	1.533-02	2.664-03	2.769-06	2.540-07	0.000
H2	1.000-30	6.493-07	5.530-03	4.202-04	1.910-07	2.463-09	0.000
H2O	6.900-02	6.602-02	3.269-02	9.737-09	2.019-11	1.493-13	0.000
N	1.000-30	3.342-15	6.088-07	1.414-04	1.131-01	2.209-01	2.593-01
NO	6.838-18	1.975-04	8.707-03	9.436-03	1.052-05	7.642-04	7.123-04
O	1.000-30	9.684-07	3.003-02	2.361-01	2.926-01	3.023-01	3.037-01
O2	4.117-02	4.843-02	7.506-02	1.289-02	1.519-05	7.072-06	6.104-06
C+	0.000	0.000	1.940-26	1.783-18	1.084-07	3.937-07	0.000
N+	0.000	0.000	9.523-25	1.740-17	4.400-08	5.222-07	8.308-07
O2-	0.000	0.000	5.645-14	5.368-13	2.359-14	1.604-14	1.478-14
CO+	0.000	0.000	1.159-18	6.196-14	4.224-08	4.120-08	0.000
NO+	0.000	0.000	7.360-10	1.732-07	4.771-05	8.900-05	9.973-05
O+	0.000	0.000	1.126-18	2.496-13	2.733-07	1.431-06	1.965-06

TIME .70000+01 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13151124

ITERATED VALUES

ITS	TIME	ALPH	FPPV	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
1	42.921	1.262	.1624	.4999	1.-07	1	5.0-02	1	9.9+02	1	-6.0-02	1	6.4-03	1	-4.8-03	0
2	47.371	1.203	.2583	.8212	1.-07	5	-4.7-02	2	1.1+03	1	-2.9-02	1	4.0-03	1	-2.3-03	1
3	49.961	1.215	.2064	1.0000	2.-07	5	2.1-01	2	1.6+03	2	-5.4-03	2	-1.4-03	2	-5.3-04	0
4	51.045	1.215	.2039	1.0000	1.-07	5	7.1-03	2	4.7+01	2	-2.7-04	2	9.7-05	2	-2.6-05	0
5	52.025	1.215	.2039	1.0000	1.-07	6	3.8-04	3	3.8+00	2	3.2-05	2	-8.6-06	2	-4.3-09	0
6	53.014	1.215	.2039	1.0000	1.-07	8	6.9-06	2	-1.3-01	2	-1.7-05	3	2.8-06	4	5.4-10	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.215+00	6.916-08	1.490-01	1.334-03	1.327+04	1.094-01	1.498-03	9.575+00	9.575+00	0.000	9.575+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3.828-01	0.000	0.000	0.000	0.000	-8.031-14	-2.458-08	2.198-08	2.605-09

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS. RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
9.280-04	9.581-04	0.000	0.000	0.000	-0.000	-1.280+01	-1.475-01	1.749-02

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2.219-02	1.714-02	1.714-02	2.807-02	9.559+02	-0.000	4.505+00	1.325+00	1.264+00

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.039-01	3.828-01	1.269+02	1.455+03	2.581+03	1.269+02	1.000+03	3.290+08
1.559-03	2.431-01	6.767-03	5.875-02	2.795-01	3.802-01	5.563+02	2.082+03	1.638+03	5.442+02	2.574+03	2.050+08
8.151-03	7.292-01	7.109-02	2.118-01	3.490-01	3.670-01	1.762+03	2.878+03	1.022+03	1.605+03	4.432+03	1.562+08
2.397-02	1.458+00	3.221-01	4.823-01	3.938-01	3.176-01	4.132+03	3.623+03	-6.198+02	3.314+03	6.267+03	1.314+08
5.601-02	2.431+00	9.559-01	8.000-01	2.598-01	1.775-01	7.362+03	3.021+03	-1.923+03	5.111+03	7.932+03	1.168+08
1.036-01	3.646+00	2.064+00	9.777-01	3.298-02	2.084-02	9.613+03	6.836+02	-3.908+02	6.249+03	8.312+03	1.141+08
2.047-01	6.076+00	4.491+00	1.000+00	-1.479-02	-9.137-03	1.012+04	-2.661+02	-3.012+02	6.603+03	8.405+03	1.135+08

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER

0.000	5.270-05	1.625-05	3.039+00	2.031-01	4.771-06	6.915-01	7.443-01	2.886+01	0.000	0.000
1.559-03	2.047-05	3.029-05	2.201+00	2.901-01	1.247-05	7.047-01	7.443-01	2.886+01	0.000	3.240-01
8.151-03	1.119-05	4.286-05	1.702+00	3.082-01	1.869-05	7.069-01	7.423-01	2.715+01	0.000	9.309-01
2.357-02	6.944-06	5.297-05	1.306+00	3.182-01	2.389-05	7.056-01	7.434-01	2.383+01	0.000	1.578+00
5.601-02	5.111-06	6.094-05	1.106+00	3.265-01	2.829-05	7.042-01	7.394-01	2.220+01	0.000	2.393+00
1.036-01	4.629-06	6.225-05	1.023+00	3.310-01	2.934-05	7.023-01	7.377-01	2.107+01	0.000	2.791+00
2.047-01	4.504-06	6.251-05	9.999-01	3.325-01	2.964-05	7.017-01	7.374-01	2.073+01	0.000	2.816+00

DISTANCE FROM WALL,FT

	0.000	1.559-03	8.151-03	2.357-02	5.601-02	1.036-01	2.047-01

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01	-1.764-01
	7.593-07	7.454-08	-2.598-08	-1.563-07	-6.700-08	-1.203-09	1.625-09
	-2.817-06	-2.068-07	-1.784-07	9.187-08	5.415-08	1.184-09	0.000
CO	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01	4.114-01
	1.331-06	-2.580-07	4.961-08	1.349-07	6.286-08	-2.508-08	1.099-08
	-6.538-06	6.327-07	1.169-07	-7.406-08	-7.236-08	1.484-08	0.000
H	0.000	-1.492-11	-2.677-11	7.151-12	5.108-11	3.896-11	0.000
	-4.532-11	-7.748-11	2.873-11	6.432-11	2.604-11	-4.598-11	1.392-11
	-1.323-10	2.185-10	4.881-11	-3.937-11	-5.926-11	2.464-11	0.000
N2	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-2.090-06	1.835-07	-2.366-08	2.139-08	4.119-09	2.633-08	-1.263-08
	9.356-06	-4.261-07	6.178-08	-1.776-08	1.827-08	-1.603-08	-0.000

MOLE FRACTIONS

C3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N2	7.881-01	7.876-01	7.328-01	6.463-01	5.376-01	4.593-01	4.361-01
E-	0.000	0.000	7.667-09	3.456-06	2.923-05	9.277-05	1.025-04
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	1.000-30	2.248-13	4.773-06	4.430-03	1.363-01	2.311-01	2.593-01
NO	5.844-09	9.321-04	1.723-02	4.343-03	1.099-03	7.803-04	7.123-04
O	5.896-20	1.869-05	1.183-01	3.442-01	3.249-01	3.056-01	3.037-01
O2	2.119-01	2.115-01	1.316-01	7.246-04	1.542-05	7.315-06	6.104-06
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N+	0.000	0.000	3.507-22	8.881-13	7.584-08	5.304-07	8.308-07
O2-	0.000	0.000	6.124-13	2.277-13	2.770-14	1.681-14	1.478-14
CO+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NO+	0.000	0.000	7.667-09	3.495-06	5.873-05	9.077-05	9.973-05
O+	0.000	0.000	1.409-16	3.083-10	4.195-07	1.468-06	1.965-06

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330-00 FEET - - -09 OCT 69 13:51:36

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX,LIN ERROR		MAX,ERRORS IN CONSERVATION EQS, MOMENTUM		ENERGY		C3		CO		H	
1	54,822	1.213	.2057	.4999	1.-07	6	-1.3-02	3	-1.1+02	2	-2.5-09	2	2.6-05	3	-1.2-09	0
2	55,832	1.210	.2076	1,0000	1.-07	6	-6.8-03	3	-5.9+01	3	1.8-06	2	-2.1-05	3	-5.9-10	0
3	56,861	1.210	.2076	1,0000	1.-07	9	-1.2-04	5	1.4+00	2	4.8-06	2	2.8-05	3	1.3-09	0
4	57,829	1.210	.2076	1,0000	1.-07	6	1.2-05	5	1.4-01	2	1.3-06	2	-2.2-05	3	-6.0-10	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL (BTU/SEC SQ FT)	TOT ENTH	RERAD	QCOND
1.210+00	1.448-09	1,4?0-01	2.942-05	1,249+04	1.124-01	2,167-04	1.375+00	1.375+00	0.000	1.375+00

WALL SHEAR (LB/SQ FT)	MASS FLUXES (LB/SEC SQ FT) MECH REM	PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
5,263-02	0.300	0,009	0.000	0,000	-1,783-14	-1,722-09	4,025-09	-2,303-09

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1,356-04	1,393-04	0,000	0.000	0,000	-0,000	-5,254-01	-1,929-02	-1,082-02

MOMENTUM THICKNESS, THETA (FT)	DISPLACE, THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE, (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1,403-01	1,195-01	1,195-01	1,789-01	2,383+01	-0,0C.	-1,369+01	-7,143+00	-6,740+00

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0,000	0,000	0,000	2,076-01	5,263-02	1,265+02	1,456+03	2,582+03	1,265+02	1,000+03	7,258+06
1,081-02	2,420-01	6,826-03	5,951-02	2,842-01	5,224-02	5,543+02	2,080+03	1,533+03	5,433+02	2,570+03	4,527+06
5,408-02	7,260-01	7,141-02	2,129-01	3,480-01	5,034-02	1,741+03	2,822+03	1,075+03	1,600+03	3,938+03	3,657+06
1,562-01	1,452+00	3,217-01	4,828-01	3,965-01	4,339-02	4,073+03	3,602+03	-6,591+02	3,346+03	6,021+03	2,958+06
3,645-01	2,420+00	9,532-01	8,000-01	2,589-01	2,418-02	7,251+03	2,964+03	-1,865+03	5,257+03	7,073+03	2,729+06
6,647-01	3,630+00	2,056+00	9,772-01	3,401-02	2,929-03	9,472+03	7,074+02	-4,043+02	6,497+03	7,344+03	2,675+06
1,302+00	6,050+00	4,472+00	1,000+00	-1,318-02	-1,277-03	1,000+04	-2,709+02	-3,002+02	6,885+03	7,4?3+03	2,666+06

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0,000	1,163-06	1,625-05	3,014+00	2,031-01	4,771-06	6,915-01	7,443-01	2,886+01	0.000	0.000
1,081-02	4,524-07	3,026-05	2,185+00	2,901-01	1,246-05	7,047-01	7,443-01	2,886+01	0.000	3.095-01
3,408-02	2,724-07	3,955-05	1,719+00	3,060-01	1,714-05	7,062-01	7,423-01	2,663+01	0.000	9.327-01
1,562-01	1,582-07	5,152-05	1,301+00	3,174-01	2,318-05	7,054-01	7,431-01	2,365+01	0.000	1.562+00
3,645-01	1,2?-07	5,626-05	1,110+00	3,264-01	2,610-05	7,037-01	7,386-01	2,170+01	0.000	2,378+00
6,647-01	1,123-07	5,711-05	1,024+00	3,312-01	2,696-05	7,016-01	7,372-01	2,048+01	0.000	2.773+00
1,302+00	1,093-07	5,731-05	1.000+00	3,328-01	2,721-05	7,006-01	7,371-01	2,012+01	0.000	2.799+00

DISTANCE FROM WALL,FT

0.000	1,081-02	5,408-02	1,562-01	3,645-01	6,647-01	1,302+00

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01
	2,230-06	2,624-07	-1,847-07	-2,131-07	-1,619-07	-3,712-08	1,235-08
	-8,130-06	-9,238-07	-3,914-08	5,295-08	1,031-07	2,044-08	0,000
CO	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01
	2,105-06	-8,425-08	-4,754-09	5,089-08	8,771-08	3,505-09	1,921-09
	-9,045-06	1,643-07	7,665-08	3,804-08	-6,742-08	-1,894-09	0,000
H	0,000	8,936-12	1,215-12	-2,633-11	-2,095-11	-8,368-13	0,000
	[illegible],165-11	3,221-11	-6,412-11	-1,177-11	2,290-11	1,035-11	-9,654-12
	-3,900-11	-1,990-10	7,210-11	3,582-11	-1,037-11	-8,264-12	0,000
N2	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01
	-4,334-06	-1,781-07	1,895-07	1,683-07	7,414-08	3,060-08	-1,426-08
	1,737-05	7,597-07	-3,756-08	-9,103-08	-3,598-08	-1,854-08	-0,000

MOLE FRACTIONS

C3	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N2	7,881-01	7,875-01	7,227-01	6,377-01	5,039-01	4,190-01	3,941-01
E-	0,000	0,000	2,115-09	5,129-06	3,922-05	5,772-05	6,308-05
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CH4	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CN	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CH	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHN	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CO2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C2H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
HO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2O	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N	1,000-30	1,416-12	1,676-06	1,500-02	1,773-01	2,802-01	3,104-01
NO	5,844-09	9,203-04	9,147-03	8,165-04	2,717-04	1,931-04	1,756-04
O	3,969-19	1,214-04	1,544-01	3,464-01	3,185-01	3,005-01	2,953-01
O2	2,119-01	2,114-01	1,138-01	3,338-05	1,805-06	8,971-07	7,519-07
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N+	0,000	0,000	2,771-24	1,153-11	4,821-08	2,788-07	4,249-07
O2-	0,000	0,000	6,790-15	4,195-16	7,952-17	4,890-17	4,293-17
CO+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
NO+	0,000	0,000	2,115-09	5,127-06	3,890-05	5,659-05	6,154-05
O+	0,000	0,000	7,200-18	1,351-09	2,713-07	8,456-07	1,115-06

TIME .00000 SECONDS - - - STREAMWISE DIMENSION .83330+00 FEET - - -09 OCT 69 13:51:41

ITERATED VALUES / MAX,ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	F2PW	DAMP	MAX,LIN ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	59,560	1.317	.0582	.2673	1.-07	1	-5.0-02	1	-1.0+03	1	5.9-02	1	-7.9-03	1	4.7-03	0
2	62,786	1.290	.1482	.6668	3.-07	5	-4.8-01	2	-3.9+03	1	4.4-02	1	-6.2-03	1	3.5-03	0
3	64,830	1.282	.1905	1.0000	2.-07	5	-1.5-01	2	-1.2+03	1	1.4-02	1	-2.0-03	1	1.1-03	0
4	66,645	1.283	.1911	1.0000	6.-08	6	-6.4-03	5	7.9+01	3	3.3-04	2	7.3-05	3	2.7-05	0
5	65,110	1.283	.1911	1.0000	1.-07	6	-6.6-04	5	6.2+00	3	3.4-05	3	-1.1-05	3	2.4-06	0
6	69,539	1.283	.1911	1.0000	1.-07	7	3.5-05	4	1.5+00	2	-1.7-05	3	-3.7-06	4	-1.8-07	0
7	70,962	1.283	.1911	1.0000	1.-07	6	5.0-06	4	1.4-01	2	8.8-06	2	-7.0-05	2	-3.0-07	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.283+00	1.448-09	1.490-01	2.942-05	1.249+04	1.124-01	2.167-04	1.409+00	1.495+00	0.000	1.345-00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
4.986-02	0.000	1.384-05	0.000	1.084-05	-6.457-07	-7.698-06	7.699-06	6.448-07

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.284-04	1.364-04	7.946-02	0.000	7.946-02	1.380-04	1.381-04	1.383-04	1.383-04

MOMENTUM THICKNESS, THETA (FT)	DISPLACE, THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE, (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.484-01	9.193-02	1.051-01	1.884-01	2.383+01	1.921-01	1.921-01	1.921-01	1.919-01

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-5.000-02	0.000	1.711-01	4.986-02	-8.896+02	1.539+03	2.900+03	-8.897+02	1.000+03	7.258+06
1.108-02	2.566-01	-4.294-02	5.805-02	2.013-01	4.970-02	-4.125+02	2.180+03	1.449+03	-4.230+02	2.515+03	4.576+06
5.378-02	7.698-01	2.391-02	2.076-01	3.216-01	4.845-02	8.966+02	2.922+03	6.127+02	7.623+02	3.602+03	3.702+06
1.431-01	1.540+00	2.843-01	4.755-01	3.743-01	4.297-02	3.387+03	3.547+03	-2.497+02	2.682+03	4.842+03	3.298+06
3.509-01	2.566+00	9.491-01	8.000-01	2.579-01	2.418-02	6.896+03	3.291+03	-2.014+03	4.902+03	4.988+03	2.746+06
6.683-01	3.849+00	2.124+00	9.822-01	2.612-02	2.247-03	9.46[illegible]+03	7.071+02	-3.874+02	6.495+03	7.339+03	2.679+06
1.345+00	6.415+00	4.689+00	1.000+00	-1.227-02	-1.032-03	1.00[illegible]+04	-2.870+02	-2.470+02	6.885+03	7.413+03	2.666+06

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOF*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	1.174-06	1.624-05	3.101+00	1.936-01	4.544-06	6.917-01	7.413-01	2.970+01	0.000	0.000
1.108-02	4.750-07	2.983-05	2.261+00	3.099-01	1.319-05	7.030-01	7.413-01	2.969+01	0.000	3.137-01
5.378-02	2.963-07	3.787-05	1.791+00	3.216-01	1.839-05	6.637-01	7.401-01	2.708+01	0.000	9.549-01
1.431-01	1.923-07	4.446-05	1.364+00	3.266-01	2.287-05	6.348-01	7.408-01	2.311+01	0.000	1.629+00
3.509-01	1.251-07	5.582-05	1.114+00	3.315-01	2.758-05	6.709-01	7.379-01	2.170+01	0.000	2.390+00
6.683-01	1.173-07	5.705-05	1.022+00	3.324-01	2.729-05	6.949-01	7.370-01	2.049+01	0.000	2.756+00
1.345+00	1.093-07	5.731-05	1.000+00	3.328-01	2.721-05	7.008-01	7.371-01	2.012+01	0.000	2.799+00

DISTANCE FROM WALL,FT

0.000 1.108-02 5.378-02 1.431-01 3.509-01 6.683-01 1.345+00

FLEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH REMPECT TO ETA

C3	-1.171-01	-1.199-01	-1.271-01	-1.407-01	-1.593-01	-1.729-01	-1.764-01
	-9.025-03	-1.243-02	-1.570-02	- 958-02	-1.673-02	-4.461-03	1.728-03
	-1.329-02	-6.389-03	-5.040-03	2.784-03	9.560-03	2.412-03	0.000
CO	4.031-01	4.035-01	4.045-01	4.064-01	4.090-01	4.109-01	4.114-01
	1.268-03	1.734-03	2.194-03	2.736-03	2.337-03	6.232-04	-2.414-04
	1.821-03	8.923-04	7.043-04	-3.890-04	-1.335-03	-3.369-04	0.000
H	4.678-03	4.460-03	3.891-03	2.819-03	1.349-03	2.766-04	0.000
	-7.120-04	-9.803-04	-1.239-03	-1.545-03	-1.320-03	-3.519-04	1.343-04
	-1.045-03	-5.040-04	-3.977-04	2.196-04	7.543-04	1.903-04	0.000
N2	7.093-01	7.119-01	7.187-01	7.314-01	7.489-01	7.617-01	7.650-01
	8.468-03	1.167-02	1.475-02	1.839-02	1.571-02	4.190-03	-1.623-03
	1.248-02	6.000-03	4.734-03	-2.614-03	-8.979-03	-2.265-03	-0.000

MOLE FRACTIONS

C3	1.000-30	1.000-30	1.000-30	8.799-28	1.684-17	1.804-18	0.000
CO	1.115-20	1.003-04	5.848-02	6.449-02	2.886-02	3.449-03	0.000
H	1.472-25	4.145-06	3.210-02	6.429-02	2.904-02	5.613-03	0.000
N2	7.519-01	7.533-01	6.922-01	6.320-01	5.057-01	4.177-01	3.941-01
E-	0.000	0.000	2.662-10	1.415-07	3.220-09	9.680-09	6.308-09
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	1.000-30	3.901-29	1.394-16	1.265-10	1.760-06	1.664-06	0.000
CH3	1.000-30	2.804-31	1.840-23	8.583-27	2.717-38	1.000-30	0.000
CN	1.000-30	1.144-24	2.802-15	5.819-11	1.986-06	1.193-06	0.000
CH	1.000-30	1.579-31	2.892-19	3.549-15	1.599-11	1.697-12	0.000
CHN	1.000-30	1.256-20	7.383-14	1.385-12	1.127-11	5.610-13	0.000
CHO	1.000-30	3.342-15	4.296-10	1.668-10	4.698-12	1.402-13	0.000
CO2	1.378-01	1.511-01	4.608-02	1.256-04	5.424-08	4.807-09	0.000
C2	1.000-30	1.000-30	4.684-28	8.037-25	3.730-11	1.393-11	0.000
C2H2	1.000-30	1.000-30	1.542-28	3.624-24	1.774-22	5.016-25	0.000
HO	1.596-13	2.380-04	1.334-02	2.718-04	2.687-07	2.705-08	0.000
H2	3.180-19	2.335-09	6.293-03	4.098-09	2.9[illegible]-08	2.830-10	0.000
H2O	6.890-02	6.246-02	2.327-02	6.574-07	2.379-[illegible]	2.143-19	0.000
N	1.000-30	5.751-13	2.617-07	2.134-04	1.482-05	2.765-01	3.104-01
NO	2.524-09	3.687-04	5.166-03	2.607-03	2.618-04	1.895-04	[illegible] 796-04
O	1.755-19	3.679-05	4.741-02	2.642-01	2.874-01	2.943-01	2.953-01
O2	4.143-07	4.936-02	7.367-02	1.738-03	1.794-06	8.710-07	7.519-07
C+	0.000	0.000	2.562-28	3.093-18	1.809-07	5.433-07	0.000
N+	0.000	0.000	1.361-26	1.993-17	2.822-06	2.698-07	4.249-07
O2-	0.000	0.000	8.903-16	1.992-15	6.827-17	[illegible].690-17	4.293-17
CO+	0.000	0.000	5.066-20	4.397-14	2.427-08	2.170-08	0.000
NO+	0.000	0.000	2.662-10	1.415-07	3.179-05	5.516-09	6.154-05
O+	0.000	0.000	9.041-20	2.203-13	1.778-07	8.140-07	1.115-06

TIME .70000+01 SECONDS - - - STREAMWISE DIMENSION .03330-00 FEET - - -09 OCT 69 13:51:54

ITERATED VALUES DAMP MAX,LIN MAX,ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	FPPW	DAMP	MAX,LIN ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	73,381	1,286	,1894	,4999	1,-07	6	1,3-02	5	-2,8+02	3	-5,9-04	3	8,2-05	3	-4,7-09	0
2	74,825	1,289	,1877	1,0000	1,-07	6	7,2-03	5	-1,5+02	4	3,3-04	4	-4,6-05	4	2,6-05	0
3	76,263	1,289	,1878	1,0000	1,-07	7	-1,1-03	4	-1,1+01	4	6,7-05	2	6,1-05	4	5,3-06	0
4	77,635	1,289	,1878	1,0000	1,-07	6	-6,0-05	4	-1,8+00	2	3,7-06	2	-4,2-05	2	-4,3-07	0
5	78,979	1,289	,1875	1,0000	1,-07	6	-1,0-05	5	2,0-01	2	-6,1-06	2	3,4-05	4	-4,1-08	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1,289+00	6,916-08	1,490-01	1,334-03	1,327+04	1,094-01	1,498-03	1,023+01	1,030+01	0,000	9,260+00

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM	PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3,628-01	0,000	7,489-05	0,000	7,489-05	-4,461-06	-5,314-05	5,307-05	4,539-06

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
8,795-04	9,258-04	8,062-02	0,000	8,062-02	9,511-04	9,509-04	9,504-04	9,567-04

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2,315-02	1,295-02	1,505-02	2,928-02	9,559+02	3,022-02	3,022-02	3,022-02	3,026-02

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0,000	-5,000-02	0,000	1,878-01	3,628-01	-8,924+02	1,521+03	2,448+03	-8,924+02	1,000+03	3,290+08
1,590-03	2,578-01	-4,300-02	5,728-02	2,565-01	3,619-01	-4,189+02	2,152+03	1,825+03	-4,308+02	2,903+03	2,079+08
8,041-03	7,734-01	2,352-02	2,063-01	3,215-01	3,535-01	8,934+02	2,938+03	9,874+02	7,437+02	4,109+03	1,623+08
2,248-02	1,547+00	2,843-01	4,744-01	3,718-01	3,132-01	3,461+03	3,702+03	-3,956+02	2,669+03	5,237+03	1,437+08
5,396-02	2,578+00	9,513-01	8,000-01	2,596-01	1,774-01	7,068+03	3,294-[illegible]	-2,042+03	4,817+03	7,824+03	1,176+08
1,043-01	3,867+00	2,133+00	9,832-01	2,468-02	1,556-02	9,618+03	6,617+02	-3,622+02	6,218+03	8,309+03	1,141+08
2,117-01	6,445+00	4,710+00	1,000+00	-1,165-02	-7,197-03	1,012+04	-2,721+02	-2,674+02	6,603+03	8,405+03	1,135+08

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSO*EPS /RHOE*MUE	MACH NUMBER
0,000	5,423-05	1,624-05	3,127+00	1,936-01	4,546-06	6,917-01	7,413-01	2,970+01	0,000	0,000
1,590-03	2,163-05	2,974-05	2,283+00	3,097-01	1,310-05	7,030-01	7,413-01	2,946+01	0,000	3,289-01
8,041-03	1,229-05	4,080-05	1,780+00	3,243-01	1,949-05	6,789-01	7,402-01	2,765+01	0,000	9,573-01
2,248-02	8,191-06	4,690-05	1,364+00	3,276-01	2,411-05	6,372-01	7,403-01	2,349+01	0,000	1,738+00
5,396-02	5,162-06	6,037-05	1,106+00	3,317-01	2,988-05	6,710-01	7,387-01	2,212+01	0,000	2,401+00
1,043-01	4,624-06	6,219-05	1,021+00	3,322-01	2,970-05	6,956-01	7,375-01	2,103+01	0,000	2,805+00
2,117-01	4,504-06	6,254-05	9,999-01	3,325-01	2,964-05	7,017-01	7,374-01	2,073+01	0,000	2,816+00

DISTANCE FROM WALL,FT

0,000	1,590-03	8,041-03	2,248-02	5,396-02	1,043-01	2,117-01

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1,170-01	-1,497-01	-1,269-01	-1,406-01	-1,594-01	-1,730-01	-1,764-01
	-8,951-03	-1,230-02	-1,580-02	-1,958-02	-1,680-02	-4,338-03	1,695-03
	-1,299-02	-6,790-03	-4,883-03	2,696-03	9,665-03	2,340-03	0,000
CO	4,031-01	4,035-01	4,049-01	4,064-01	4,070-01	4,109-01	4,114-01
	1,246-03	1,720-03	2,207-03	2,739-03	2,346-03	6,060-04	-2,367-04
	1,839-03	9,455-04	6,822-04	-3,767-04	-1,350-03	-3,269-04	0,000
H	4,690-03	4,474-03	3,903-03	2,823-03	1,344-03	2,689-04	0,000
	-7,061-04	-9,703-04	-1,247-03	-1,545-03	-1,325-03	-3,423-04	1,337-04
	-1,025-03	-5,358-04	-3,852-04	2,127-04	7,625-04	1,846-04	0,000
N2	7,092-01	7,117-01	7,185-01	7,314-01	7,490-01	7,618-01	7,650-01
	8,411-03	1,155-02	1,484-02	1,839-02	1,578-02	4,075-03	-1,592-03
	1,218-02	6,380-03	4,586-03	-2,532-03	-9,077-03	-2,198-03	-0,000

MOLE FRACTIONS

C3	1,000-30	1,000-30	1,389-33	1,658-26	2,171-16	2,404-17	0,000
CO	1,671-21	1,343-05	5,424-02	6,471-02	2,933-02	5,449-03	0,000
H	8,462-27	2,073-07	1,830-02	6,258-02	2,948-02	5,610-03	0,000
N2	7,518-01	7,533-01	7,047-01	6,086-01	5,343-01	4,573-01	4,361-01
E-	0,000	0,000	9,116-10	1,945-09	6,817-05	9,114-05	1,025-04
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C	1,000-30	5,587-31	3,059-15	1,230-10	1,495-04	1,576-04	0,000
CH4	1,000-30	2,102-31	5,182-21	9,604-23	3,414-28	2,978-32	0,000
CN	1,000-30	1,226-25	8,509-14	1,568-10	4,891-06	3,145-06	0,000
CH	1,000-30	5,900-33	1,904-17	4,556-14	1,863-10	2,06[illegible]-11	0,000
CHN	1,000-30	3,802-21	2,030-12	2,541-11	2,075-10	1,054-11	0,000
CHO	1,000-30	1,070-15	4,596-09	4,144-09	1,402-10	3,989-12	0,000
CO2	1,382-01	1,316-01	5,281-02	1,080-03	4,464-07	3,703-08	0,000
C2	1,000-30	1,000-30	2,688-25	4,457-19	1,609-10	6,722-11	0,000
C2H2	1,000-30	1,000-30	9,303-24	1,112-21	4,986-20	1,407-22	0,000
HO	5,151-14	8,594-05	1,589-02	2,383-03	2,772-06	2,616-07	0,000
H2	4,763-20	3,169-06	3,760-03	3,792-04	1,514-07	2,607-09	0,000
H2O	6,910-02	6,578-02	3,067-02	4,442-05	2,020-11	1,577-15	0,000
N	1,000-30	7,052-14	7,376-07	1,617-04	1,131-01	2,283-01	2,593-01
NO	2,509-09	3,533-04	9,027-03	9,127-03	1,052-03	7,683-04	7,123-04
O	2,592-20	4,911-06	3,345-02	2,394-01	2,925-01	3,022-01	3,037-01
O2	4,096-02	4,886-02	7,519-02	1,149-02	1,518-05	7,093-06	6,104-06
C+	0,000	0,000	3,738-26	2,917-18	1,086-07	3,994-07	0,000
N+	0,000	0,000	1,718-24	2,666-17	4,400-08	5,168-07	8,308-07
O2+	0,000	0,000	6,660-14	5,176-13	2,357-14	1,607-14	1,478-14
CO+	0,000	0,000	1,761-18	8,152-14	4,231-08	4,202-08	0,000
NO+	0,000	0,000	9,116-10	1,945-07	4,771-05	8,876-05	9,973-05
O+	0,000	0,000	1,787-18	3,255-13	2,733-07	1,421-06	1,965-06

```
- - - - - - - - - - - - - - -      1.0000 SECONDS  - - - - - - - - - - - - - - -
TIME  SURF  PROB  SURFACE     H WALL     H EDGE      HEAT COEFF         CH/CHO
STEP  ITER  OPTN  RAD (IN)   (BTU/LB)   (BTU/LB)   (LB/SQ FT-SEC)
  8     3     0    1.7880    -2112.31       .00        .0004            1.00000

                               ---ABLATION RATES---
  B PRIME    B PRIME G   M DOT CHAR   M DOT GAS        M CHAR         M GAS
                           (LB/SQ FT-SEC)             (LB/ORIG SQ FT)
   .00001     .00000      .000000      .000000        .000000       .000000

                        ---RECESSIONS/RECESSION RATES---
                               (IN)    /    (IN/SEC)
        SURFACE                      CHAR ( .02)            PYROLYSIS ( .98)
  .0000000/ .0000000          .0000000/ .0000000        .0000000/ .0000000

                        ---SURFACE ENERGY FLUX TERMS---
                       CURRENT RATES (BTU/SQ FT SURFACE-SEC)
                      AND INTEGRATED VALUES (BTU/ORIG SQ FT)
         CONVECTED        RADIATED        RADIATED        CHEMICAL       CONDUCTION
            IN               IN              OUT          GENERATION        AWAY
RATE      .255+01           .000            .000             .000          .255+01
TOTAL     .214+01           .00?            .000             .000          .214+01

                         ---INTERIOR ENERGY TERMS---
                       CURRENT RATES (BTU/SQ FT SURFACE-SEC)
                      AND INTEGRATED VALUES (BTU/ORIG SQ FT)
         PYROL GAS         DECOMP       CONVECTION        STORAGE         LOSS AT
          PICK UP        ABSORPTION     WITH SOLIDS       IN SOLID       REAR FACE
RATE      -.000            -.000          .231-07          .255+01        -.132-10
TOTAL     -.000            -.000          .152-07          .214+01        -.113-10

NODE MAT   TEMP     DENSITY     ENTHALPY   NODE MAT   TEMP     DENSITY     ENTHALPY
          (DEG R) (LB/CU FT)   (BTU/LB)             (DEG R)  (LB/CU FT)   (BTU/LB)
  1   1   566.44    91.300     -367.83      9   1   530.04    91.300     -378.20
  2   1   555.32    91.300     -371.00     10   1   530.01    91.300     -378.21
  3   1   546.44    91.300     -373.52     11   1   530.00    91.300     -378.21
  4   1   539.33    91.300     -375.55     12   1   530.00    91.300     -378.21
  5   1   534.23    91.300     -377.00     13   1   530.00    91.300     -378.21
  6   1   531.68    91.300     -377.73     14   1   530.00    91.300     -378.21
  7   1   530.36    91.300     -378.02     15   1   530.00    91.300     -378.21
  8   1   530.17    91.300     -378.14
```

- - - - - - - - - - - - - - 2.0000 SECONDS - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
11	3	0	1.7880	-2076.79	.00	.0006	1.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00001	.00000	.000000	.000000	.000000	.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	.0000000/ .0000000	.0000000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.371+01	.000	.000	.000	.371+01
TOTAL	.547-01	.000	.000	.000	.547+01

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	-.000	-.000	.106-06	.371+01	-.192-10
TOTAL	-.000	-.000	.931-07	.547+01	-.284-10

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	600.08	91.300	-358.24	9	1	530.32	91.300	-378.12
2	1	583.25	91.300	-363.03	10	1	530.09	91.300	-378.19
3	1	568.94	91.300	-367.11	11	1	530.01	91.300	-378.21
4	1	555.71	91.300	-370.88	12	1	530.00	91.300	-378.21
5	1	544.45	91.300	-374.09	13	1	530.00	91.300	-378.21
6	1	537.20	91.300	-376.16	14	1	530.00	91.300	-378.21
7	1	533.51	91.300	-377.21	15	1	530.00	91.300	-378.21
8	1	531.17	91.300	-377.88					

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AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM
                                                                PAGE  7

- - - - - - - - - - - - - - -      3.0000 SECONDS  - - - - - - - - - - - - - - -
TIME  SURF  PROB  SURFACE      H WALL     H EDGE      HEAT COEFF        CH/CHO
STEP  ITER  OPTN  RAD (IN)   (BTU/LB)   (BTU/LB)   (LB/SQ FT-SEC)
 14     3     0    1.7880    -2043.05       .00         .0008          1.00000

                           ---ABLATION RATES---
  B PRIME    B PRIME G   M DOT CHAR    M DOT GAS       M CHAR         M GAS
                            (LB/SQ FT-SEC)             (LB/ORIG SQ FT)
   .00001    -.00000      .000000      -.000000       .000000      -.000000

                      ---RECESSIONS/RECESSION RATES---
                            (IN)    /    (IN/SEC)
          SURFACE                   CHAR ( .02)              PYROLYSIS ( .96)
  .0000000/ .0000000        .0030000/ .0000000         .0050000/ .0000000

                      ---SURFACE ENERGY FLUX TERMS---
                    CURRENT RATES (BTU/SQ FT SURFACE-SEC)
                   AND INTEGRATED VALUES (BTU/ORIG SQ FT)
          CONVECTED      RADIATED       RADIATED      CHEMICAL       CONDUCTION
             IN             IN             OUT        GENERATION        AWAY
RATE       .489+01        .000           .000           .000          .489+01
TOTAL      .996+01        .000           .000           .000          .996+01

                      ---INTERIOR ENERGY TERMS---
                    CURRENT RATES (BTU/SQ FT SURFACE-SEC)
                   AND INTEGRATED VALUES (BTU/ORIG SQ FT)
          PYROL GAS       DECOMP       CONVECTION      STORAGE        LOSS AT
           PICK UP      ABSORPTION     WITH SOLIDS     IN SOLID      REAR FACE
RATE      -.341-08        .642-07        .230-06        .489+01       -.281-10
TOTAL     -.114-08        .335-07        .278-06        .996+01       -.916-10

NODE MAT    TEMP     DENSITY    ENTHALPY   NODE MAT    TEMP     DENSITY    ENTHALPY
          (DEG R) (LB/CU FT)  (BTU/LB)              (DEG R) (LB/CU FT)  (BTU/LB)
  1   1   636.69    91.300    -347.80     9   1    531.18    91.300    -377.88
  2   1   614.43    91.300    -354.15    10   1    530.38    91.300    -378.10
  3   1   595.00    91.300    -359.68    11   1    530.05    91.300    -378.19
  4   1   575.98    91.300    -365.11    12   1    530.00    91.300    -378.21
  5   1   558.64    91.300    -370.05    13   1    530.00    91.300    -378.21
  6   1   546.13    91.300    -373.61    14   1    530.00    91.300    -378.21
  7   1   538.89    91.300    -375.68    15   1    530.00    91.300    -378.21
  8   1   533.57    91.300    -377.19
```

- - - - - - - - - - - - - - 4.0000 SECONDS - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
17	3	0	1.7880	-2006.75	.00	.0009	1.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00001	-.00000	.000000	-.000000	.000000	-.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	.0030000/ .0000000	.0090000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.606+01	.000	.000	.000	.606+01
TOTAL	.156+02	.000	.000	.000	.156+02

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	-.283-07	.138-06	.406-06	.606+01	-.307-10
TOTAL	-.190-07	.148-06	.622-06	.156+02	-.804-10

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	675.82	91.300	-336.65	9	1	532.86	91.300	-377.39
2	1	648.38	91.300	-344.48	10	1	531.07	91.300	-377.91
3	1	623.97	91.300	-351.43	11	1	530.19	91.300	-378.16
4	1	599.30	91.300	-358.46	12	1	530.02	91.300	-378.20
5	1	575.90	91.300	-365.13	13	1	530.00	91.300	-378.21
6	1	557.89	91.300	-370.26	14	1	530.00	91.300	-378.21
7	1	546.64	91.300	-373.47	15	1	530.00	91.300	-378.21
8	1	537.56	91.300	-376.06					

AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM

- - - - - - - - - - - - - - 5.0000 SECONDS - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
20	3	0	1.7880	-1968.41	.00	.0011	1.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00001	-.00000	.000000	-.000000	.000000	-.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	.0030000/ .0000000	.0090000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.723+01	.000	.000	.000	.723+01
TOTAL	.225+02	.000	.000	.000	.225+02

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	-.797-07	.198-06	.638-06	.723+01	-.389-10
TOTAL	-.803-07	.327-06	.118-05	.225+02	-.115-09

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	716.93	91.300	-324.93	9	1	535.54	91.300	-376.63
2	1	684.45	91.300	-334.19	10	1	532.29	91.300	-377.56
3	1	655.26	91.300	-342.51	11	1	530.47	91.300	-378.08
4	1	625.08	91.300	-351.11	12	1	530.07	91.300	-378.19
5	1	595.68	91.300	-359.49	13	1	530.00	91.300	-378.21
6	1	572.05	91.300	-366.23	14	1	530.00	91.300	-378.21
7	1	556.50	91.300	-370.66	15	1	530.00	91.300	-378.21
8	1	543.16	91.300	-374.46					

AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM

- - - - - - - - - - - - - - - 6.0000 SECONDS - - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
23	3	0	1.7880	-1928.51	.00	.0013	1.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00001	-.00000	.000000	-.000000	.000000	-.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	**********/*********	.0050000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.841+01	.000	.000	.000	.841+01
TOTAL	.305+02	.000	.000	.000	.305+02

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	-.150-06	.235-06	.926-06	.841+01	-.408-10
TOTAL	-.203-06	.547-06	.200-05	.305+02	-.154-09

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	759.55	91.300	-312.79	9	1	539.28	91.300	-375.57
2	1	722.25	91.300	-323.[illegible]2	10	1	534.16	91.300	-377.02
3	1	688.42	91.300	-333.06	11	1	530.94	91.300	-377.93
4	1	652.86	91.300	-343.20	12	1	536.17	91.300	-378.16
5	1	617.54	91.300	-353.26	13	1	530.01	91.300	-378.21
6	1	588.25	91.300	-361.61	14	1	530.00	91.300	-378.21
7	1	568.25	91.300	-367.31	15	1	530.00	91.300	-378.21
8	1	550.32	91.300	-372.42					

- - - - - - - - - - - - - - - 7.000C SECONDS - - - - - - - - - - - - - - -

TIME STEP	SURF ITER	PROB OPTN	SURFACE RAD (IN)	H WALL (BTU/LB)	H EDGE (BTU/LB)	HEAT COEFF (LB/SQ FT-SEC)	CH/CHO
26	3	0	1.7880	-1887.41	.00	.0015	1.00000

---ABLATION RATES---

B PRIME	B PRIME G	M DOT CHAR (LB/SQ FT-SEC)	M DOT GAS (LB/SQ FT-SEC)	M CHAR (LB/ORIG SQ FT)	M GAS (LB/ORIG SQ FT)
.00001	-.00000	.000000	-.000000	.000000	-.000000

---RECESSIONS/RECESSION RATES---
(IN) / (IN/SEC)

SURFACE	CHAR (.02)	PYROLYSIS (.98)
.0000000/ .0000000	**********/*********	.0050000/ .0000000

---SURFACE ENERGY FLUX TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	CONVECTED IN	RADIATED IN	RADIATED OUT	CHEMICAL GENERATION	CONDUCTION AWAY
RATE	.959+01	.000	.000	.000	.959+01
TOTAL	.397+02	.000	.000	.000	.397+02

---INTERIOR ENERGY TERMS---
CURRENT RATES (BTU/SQ FT SURFACE-SEC)
AND INTEGRATED VALUES (BTU/ORIG SQ FT)

	PYROL GAS PICK UP	DECOMP ABSORPTION	CONVECTION WITH SOLIDS	STORAGE IN SOLID	LOSS AT REAR FACE
RATE	-.237-06	.249-06	.127-05	.959+01	-.442-10
TOTAL	-.410-06	.792-06	.316-05	.397+02	-.197-09

NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)	NODE	MAT	TEMP (DEG R)	DENSITY (LB/CU FT)	ENTHALPY (BTU/LB)
1	1	803.33	91.300	-300.06	9	1	544.08	91.300	-374.20
2	1	761.40	91.300	-312.26	10	1	536.74	91.300	-376.29
3	1	723.08	91.300	-323.18	11	1	531.77	91.300	-377.71
4	1	682.28	91.300	-334.81	12	1	530.35	91.300	-378.11
5	1	641.14	91.300	-346.53	13	1	530.04	91.300	-378.20
6	1	606.20	91.300	-356.49	14	1	530.00	91.300	-378.21
7	1	581.66	91.300	-363.49	15	1	530.00	91.300	-378.21
8	1	558.91	91.300	-369.97					

```
      TIME   ,70000+01 SECONDS - - - STREAMWISE DIMENSION   ,83330-00 FEET - - -09 OCT 69 13:52:04

ITERATED VALUES              DAMP  MAX,LIN   MAX,ERRORS IN CONSERVATION EQS,
ITS   TIME   ALPH   FPPW            ERROR  MOMENTUM    ENERGY    C3          CO          H
 1   82,303 1,252  ,1919 ,4999  1,-07  1  9,0-02  1  1,0+03  1 -1,0-02  1  8,4-03  1 -4,0-03  0
 2   86,916 1,220  ,19261,0000  4,-07  1  2,9-02  1  4,8+02  1 -3,0-02  1  9,0-03  1 -2,3-03  2
 3   88,113 1,229  ,18941,0000  2,-07  7  7,9-03  4  1,9+02  2  8,3-04  1 -9,0-04  2  3,9-05  0
 4   89 340 1,234  ,18921,0000  2,-07  6  1,7-03  3  1,4+01  2 -2,9-05  2  1,0-04  6  1,6-07  0
```

5 90,91 1.224 ,18931,0000 1,-07 5 -2,5-05 3 4,9-01 2 -2,2-05 2 -1,9-06 4 -1,1-09 0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1,224+00	6,916-04	1,490-01	1,334-03	1,327+04	1,094-01	1,498-03	9,639+00	9,639+00	0,000	9,630+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3,829-01	0,000	-2,170-09	1,498-08	1,281-08	-9,219-14	-4,766-08	4,432-08	3,343-09

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
9,282-04	9,608-04	-2,259-06	1,599-05	1,353-05	-0,000	3,271-03	3,978-03	9,781-04

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2,223-02	1,671-02	1,671-02	2,813-02	9,589+08	-0,000	3,042-02	3,944-02	9,340-04

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0,000	-8,551-06	0,000	1,893-01	3,829-01	9,105+01	1,320+03	2,912+03	9,104+01	8,033+02	3,670+08
1,437-03	2,448-01	6,502-03	5,661-02	2,732-01	3,807-01	9,036+02	2,048+03	1,690+03	4,923+02	2,397+03	2,129+08
7,867-03	7,345-01	6,992-02	2,084-01	3,468-01	3,478-01	1,706+03	2,809+03	1,829+03	1,553+03	4,396+03	1,549+08
2,316-02	1,469+00	3,207-01	4,802-01	3,932-01	3,187-01	4,091+03	3,628+03	-6,041+02	3,280+03	6,190+03	1,322+08
5,571-02	2,448+00	9,582-01	8,000-01	2,600-01	1,777-01	7,391+03	3,033+03	-1,928+03	5,100+03	7,928+03	1,160+08
1,036-01	3,673+00	2,075+00	9,786-01	3,184-02	2,011-02	9,620+03	6,728+02	-3,887+02	6,251+03	8,313+03	1,141+08
2,055-01	6,121+00	4,521+00	1,000+00	-1,438-02	-8,885-03	1,012+04	-2,642+02	-2,985+02	6,603+03	8,405+03	1,139+08

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0,000	6,560-05	1,406-05	3,275+00	1,494-01	3,105-06	6,767-01	7,443-01	2,886+01	0,100	0,000
1,437-03	2,199-05	2,890-05	2,256+00	2,872-01	1,179-05	7,044-01	7,443-01	2,886+01	0,100	3,228-01
7,867-03	1,133-05	4,266-05	1,717+00	3,079-01	1,858-05	7,069-01	7,424-01	2,729+01	0,000	9,230-01
2,316-02	7,035-06	5,254-05	1,312+00	3,178-01	2,367-05	7,056-01	7,434-01	2,389+01	0,000	1,577+00
5,571-02	5,116-06	6,093-05	1,107+00	3,264-01	2,824-05	7,042-01	7,395-01	2,221+01	0,000	2,394+00
1,036-01	4,628-06	6,225-05	1,023+00	3,310-01	2,934-05	7,083-01	7,377-01	2,107+01	0,000	2,703+00
2,055-01	4,504-06	6,254-05	9,999-01	3,325-01	2,964-05	7,017-01	7,374-01	2,073+01	0,000	2,816+00

DISTANCE FROM WALL,FT

	0,000	1,437-03	7,867-03	2,316-02	5,571-02	1,036-01	2,055-01

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01	-1,764-01
	2,198-06	-3,836-06	-4,989-06	-6,179-06	-5,125-06	-1,443-06	5,246-07
	-2,465-05	-2,354-06	-1,621-06	1,077-06	3,008-06	8,037-07	0,000
CC	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01	4,114-01
	-7,940-07	1,250-06	1,730-06	2,175-06	1,854-06	4,794-07	-1,713-07
	8,347-06	9,811-07	6,093-07	-3,270-07	-1,126-06	-2,641-07	0,000
H	0,000	-2,473-12	1,719-11	1,045-12	-4,579-11	-1,106-11	0,000

	-1,051-11	-9,688-12	9,000-11	-1,340-10	3,821-11	1,844-11	-9,4 6-12
	3,368-12	2,036-10	-3,049-10	1,759-10	-1,624-11	-1,137-11	0,000
N2	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01	7,650-01
	-1,404-06	2,586-06	3,258-06	4,005-06	3,271-06	9,677-07	-3,933-07
	1,630-05	1,372-06	1,016-06	-7,498-07	-1,881-06	-5,399-07	-8,000

MOLE FRACTIONS

C3	1,000-30	0,000	0,000	0,000	0,000	0,000	0,000
CO	5,857-32	0,000	0,000	0,000	0,000	0,000	0,000
H	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N2	7,881-01	7,878-01	7,366-01	6,470-01	5,383-01	4,592-01	4,361-01
E-	0,000	0,000	6,302-09	2,914-06	5,890-05	9,285-05	1,029-04
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
C	1,000-30	0,000	0,000	0,000	0,000	0,000	0,000
CH4	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CN	1,000-30	0,000	0,000	0,000	0,000	0,000	0,000
CH	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHN	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CHO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
CO2	3,501-05	0,000	0,000	0,000	0,000	0,000	0,000
C2	1,009-30	0,000	0,000	0,000	0,000	0,000	0,000
C2H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
HO	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2	0,000	0,000	0,000	0,000	0,000	0,000	0,000
H2C	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N	1,000-30	1,145-14	3,942-06	3,604-03	1,354-01	2,313-01	2,593-01
NO	4,771-11	5,308-04	1,702-02	4,663-03	1,103-03	7,790-04	7,123-04
O	9,965-26	3,846-06	1,090-01	3,438-01	3,251-01	3,089-01	3,037-01
O2	2,119-01	2,117-01	1,374-01	9,009-04	1,959-05	7,307-06	6,104-06
C+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
N+	0,000	0,000	1,761-22	4,584-13	7,409-08	5,320-07	8,308-07
O2+	0,000	0,000	5,523-13	2,530-13	2,786-14	1,679-14	1,478-14
CO+	0,000	0,000	0,000	0,000	0,000	0,000	0,000
NO+	0,000	0,000	6,303-09	2,914-06	5,841-05	9,082-05	9,973-05
O+	0,000	0,000	9,118-17	2,019-10	4,133-07	1,470-06	1,965-06

4. CABLE LISTINGS AND FLOW CHARTS

a. Program CABLE - C00A

(1) Function

Main Program. Calls DUMCOM, DM2COM, INPOUT, SETUP, CMA, BLIMP, LOOK.

(2) **Listing**

```
      CC30A                                                             C00A 001
         DIMENSION FT(21)
          COMMON/CA COM/TLMC(20,10,2),TMG(20),TTS(20,10,2),TCHEM(20,10,2),   C00A 002
         1H C(20), I(20),KHI(20),JCMA,IMG,IMC,NMG,                      C00A 003
         2TCM(2),THE(2),TRAD(2),IAB                                     C00A 004
         3,TT2(20,2),THZ(20,2),TT1(30),THG(30),DH12(2),TA(30),DELHG,I1,I2,CHC00A 005
         4,C D,HPR ,KCM(10)                                             C00A 006
          COMMON/BL COM/  MOA( 71),  MOF( 71),NSPEC,FR( 71,15),W(3),LEF(10) C00A   7
         1,LEFS(10),PIEASF,LEFA(10)                                     C00A   8
          COMMON/FL COM/DELGA,DELJA( 8),DJNL(153),DJNL(153, 8),WALLG    C00A   9
         1,WALLJ( ), ,  JKK( 9),TPWALL                                  C00A  10
          COMMON/MISC  /C1,C2,C3,C4,ALPHO,BETA,ZH(4,14),ZG(4,14),ZSP(4,14, 8C00A  11
         1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUF,HHUE,HFW,DLX2  C00A  12
         2, S (40), ETAN(40)                                            C00A  13
          COMMON/I TCOM/ KH(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NC00A  14
         1S,IT,  I  , SP,NSPM1, AM,NLFQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) C00A  15
         2, (4),        E, ON,K0(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) C00A  16
         3,KAUX ,JTIME,JSPEC,MD(3)                                      C00A  17
          COMMON/PRECOM/TITLE( 50),PPE(40),PTET( 50),GE( 50),S(40),ROKAP(40) C00A  18
         1,  OSE,VKAP,MDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  C00A  19
         2C  E,RADFL( 50),RADR(40),RADS(40),IRAD                        C00A  20
          COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),OR(15),H(15)   C00A  21
         1,CPBAR(15),VMK(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  C00A  22
         2D SK( 8),DMU4K( 8),DTK( 8),DPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)C00A  23
         3, HTILK( 8),D RK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)  C00A  24
         4,DPHIKK( 8, 8),        DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL   C00A  25
         5,VMU3,DTH,DCAPCH,DPRH,DSCH,DORH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP C00A  26
         6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)  C00A  27
          COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                C00A  28
          COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)      C00A  29
         1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ  C00A  30
          COMMON/ESTCOM/SIP,HIP                                              *NEW
          DATA VOID/4HVOID/                                             C00A 023
          DATA SEG1/6HSEG1  /                                           C00A 024
          DATA SEG2/6HSEG2  /                                           C00A 025
          DATA SEG3/6HSEG3  /                                           C00A 026
          DATA SEG4/6HSEG4  /                                           C00A 027
     7234 FORMAT(10I1,3I5,35X,20I1)
     C***** ALSO DEFINED IN INPOUT,INPUT,CRECT AND RERAY
          CALL SETIO(3,1)
          CALL SETIO(5,2)
          CALL SETDA( 3, 000000,500000,FT(1))
          KIN=
          KOUT=5
          READ(KIN,7234) KCM,ITEM,IS,NITEM,KR
          KR(12)=1
          KR(2)=2
          KR17=KR(17)
     C    IF KCM(10) = 0, DO NOTHING
     C    IF KCM(10) = 1, SAVE
     C    IF KCM(10) = 2, RESTART -- NO SAVE
     C    IF KCM(10) = 3, RESTART -- SAVE
          IF (KCM(10)) 90,90,93
       90 CALL SETDA(13, 500000,500000,FT(8))
          CALL SETDA(14,1000000,500000,FT(15))
          GO TO 95
       93 REWIND 12
       95 REWIND 13
```

```
      REWIND 14
      B(1)=.5                                              C00A 031
      B(2)=.33333333                                       C00A 032
      B(3)=.16666666                                       C00A 033
      B(4)=.125                                            C00A 034
      B(5)=.041666666                                      C00A 035
      B(6)=.033333333                                      C00A 036
      B(7)=.013888884                                      C00A 037
      B(8)=.003968254                                      C00A 038
      IRW = 0
      LIM = 1
      IF (KCM(11) - 2) 102,100,100
C     RESTART
  100 NBT=13
      DO 107 IRW=1,2
      LIM=((IS-IRW+2)/2-1)*NITEM+ITEM-MOD(IS-1+IRW,2)
      IF(LIM) 107,107,109
  109 DO 108 I=1,LIM
  108 READ(NBT) HSTEQV
  107 NBT=14
      IRW=101
      LIM = (IS-1)*NITEM + ITEM
  102 DO 103 I = 1,LIM
      CALL DU1COM(IRW)
  103 CALL DM2COM(IRW)
      IF(IRW) 104,104,147
  104 NS=1
      IT=1                                                 C00A 041
  105 IS=0                                                 C00A 042
      MCE=-1                                               C00A 043
      JCMA=1                                               C00A 044
  110 IS=IS+1                                              C00A 045
      IF (IS-NS) 115,115,105
  115 CONTINUE
C     CALL LOAD(SEG3)                                      C00A 047
      CALL INPOUT                                          C00A 048
      ITEM=1                                               C00A 049
  120 J=MOD(ITEM,2)+1                                      C00A 050
      DO 129 IMG=1,NMG                                     C00A 051
      LIMC=NMI(IMG)                                        C00A 052
      DO 129 IMC=1,LIMC                                    C00A 053
  129 TCHEM(IMC,IMG,J)=VOID                                C00A 054
C     CALL LOAD (SEG4)                                     C00A 055
C     REWIND 10                                            C00A 056
      CALL SETUP                                           C00A 057
      TPR(J)=TIME(ITEM)                                    C00A 058
      TCR(J)=-1./C3M(IS)                                   C00A 059
      TRAD(J)=RADS(IS)
      IF(ITEM-1) 128,128,130                               C00A 061
  128 TPR(1)=TIME(NITEM)                                   C00A 062
  130 CONTINUE
C     CALL LOAD(SEG1)                                      C00A 063
      CALL CMA                                             C00A 064
C     CALL LOAD(SEG2)                                      C00A 065
      KC(11)=3+IAB                                         C00A 066
      LIM=0                                                C00A 067
      IF(JCMA-3) 140,150,160                               C00A 068
  140 IF(JCMA) 141,141,142                                 C00A 069
  141 WRITE(NBT)  KCM                                      C00A 070
      STOP                                                 C00A 071
```

```
  142 FLUXJ(1,IS,IT)=0.
      FLUXJ(2,IS,IT)=-HPRMG
      FLUXJ(3,IS,IT)=-CMD/CH
      T (IS,IT)=TA(1)
      KR(11)=3                                                    COOA 075
      CALL BLIMP
  145 IF (IABS(KCH(10)-2)-1) 147,146,147                          COOA 076
  146 CALL DUMCOM(102)
      CALL DM2COM(102)
  147 ITEM = ITEM+1
      IF(JCMA-1) 110,110,120
  150 LIM=4                                                       COOA 078
      KR(11)=4                                                    COOA 079
  160 II=I1                                                       COOA 080
C     REWIND 10                                                   COOA 081
      J=MOD(ITEM,2)+1                                             COOA 082
      DO 280 K=1,LIM                                              COOA 083
      IF(TCHEM(II,IMG,J)-VOID) 209,170,209                        COOA 084
  170 FLUXJ(1,IS,IT)=0.                                           COOA 085
      FLUXJ(2,IS,IT)=-TMG(IMG)
      IF(JCMA-4) 180,180,190
  180 FLUXJ(3,IS,IT)=-EXP(TLMC(II,IMG,J))                         COOA 088
      GO TO 200
  190 FLUXJ(3,IS,IT)=0.                                           COOA 090
      T (IS,1)=TTS(II,IMG,J)
  200 CALL BLIMP                                                  COOA 092
      CALL LOOK(2,T(1),TT1,THG,0,0,0,HGA,CT1,1)                   COOA 093
      HGA=HGA+DELHG                                               COOA 094
      CALL LOOK(4,T(1),TT2(1,2),THZ(1,2),0,0,0,HCH,CT2,1)         COOA 095
      HCH=HCH+DH12(2)                                             COOA 096
      IF(JCMA.GT.4) TLMC(II,IMG,J)=ALOG(AMAX1(-W(3),0.00001))     COOA 097
      TCHEM(II,IMG,J)=(W(2)+W(3))*WIP*1.8+WALLQ-W(2)*HGA-W(3)*HCH
      TTS(II,IMG,J)=T(1)
  209 GO TO (210,220,260,250,210,230,260,250),K                   COOA 099
  210 ITEM=ITEM-1                                                 COOA 100
      GO TO 270                                                   COOA 101
  220 II=I2                                                       COOA 102
      GO TO 240                                                   COOA 103
  230 II=I2+1                                                     COOA 104
  240 IMG=IMG+1                                                   COOA 105
      GO TO 280                                                   COOA 106
  250 IMG=IMG-1                                                   COOA 107
      II=I1+1                                                     COOA 108
      GO TO 280                                                   COOA 109
  260 ITEM=ITEM+1                                                 COOA 110
  270 J=3-J                                                       COOA 111
  280 CONTINUE                                                    COOA 112
      GO TO 130                                                   COOA 113
      END                                                         COOA 114
                                                                  COOA 115
```

(3) Flow Chart

```
CCOOA
      DATA VOID/4HVOID/
      DATA SE01/6HSE01  /
      DATA SE02/6HSE02  /
      DATA SE03/6HSE03  /
      DATA SE04/6HSE04  /
 7234 FORMAT(10I1,3I5,35X,20I1)
C**N.B.**ALSO DEFINED IN INPOUT,INPUT,CRECT AND RERRY
      CALL SETIO(8,1)
      CALL SETIO(5,2)
      CALL SETDR( 3, 000000,500000,FT(1))
      KIN=8
      KOUT=6
      READ(KIN,7234) KCM,ITEM,IS,NITEM,KR
      KR(12)=1
      KR(2)=2
      KR17=KR(17)
C     IF KCM(10) = 0, DO NOTHING
C     IF KCM(10) = 1, SAVE
C     IF KCM(10) = 2, RESTART -- NO SAVE
C     IF KCM(10) = 3, RESTART -- SAVE
```

```
      IF (KCM(10)) 90,90,93
```

```
   90 CALL SETDR(13, 500000,500000,FT(8))
      CALL SETDR(14,1000000,500000,FT(15))
```

```
      GO TO 95
```

```
   93 REWIND 12
```

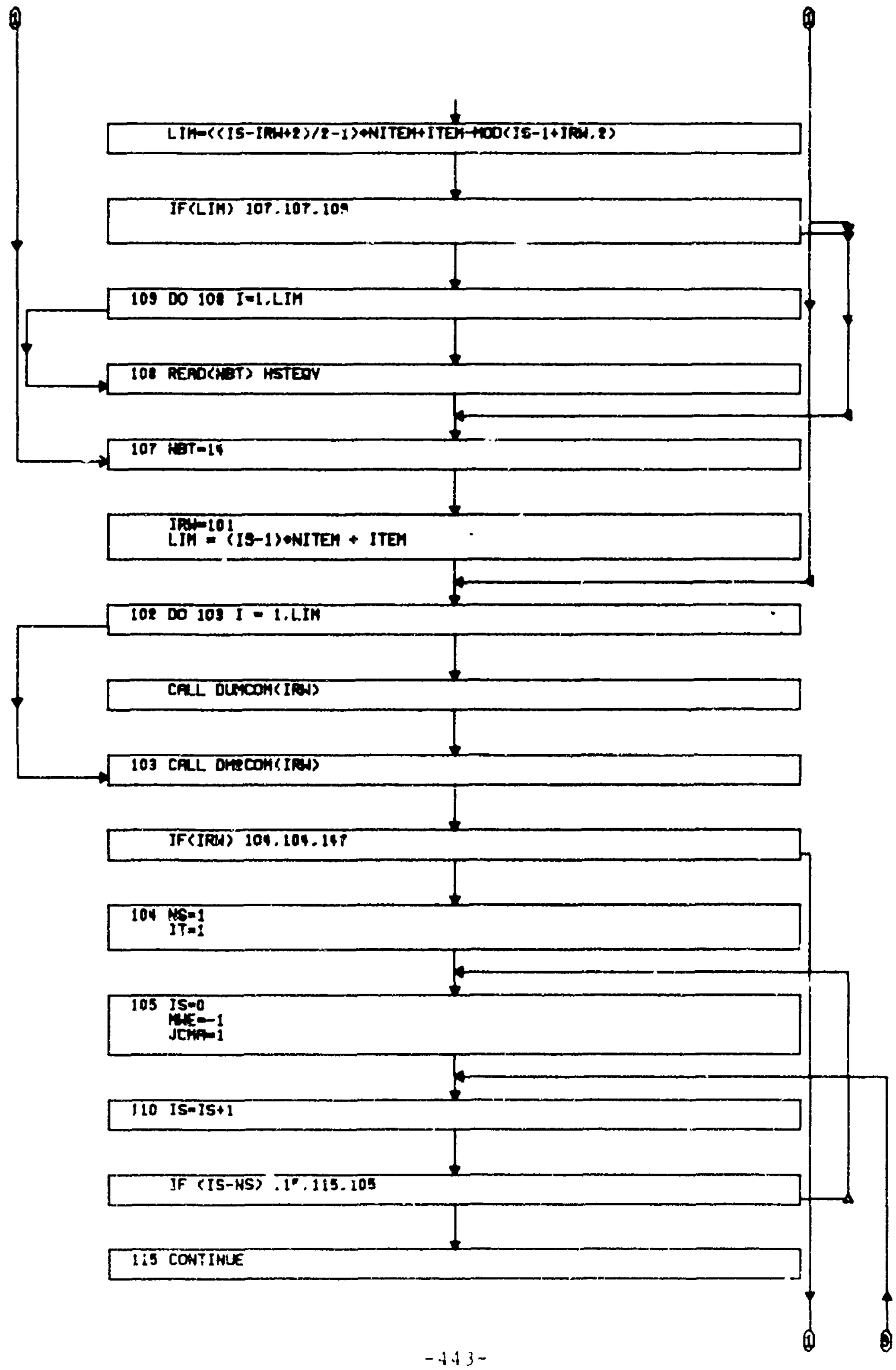
```
   95 REWIND 13
      REWIND 14
      B(1)=.5
      B(2)=.333333333
      B(3)=.166666636
      B(4)=.125
      B(5)=.041666666
      B(6)=.033333333
      B(7)=.013888888
      B(8)=.003968254
      IRW = 0
      LIM = 1
```

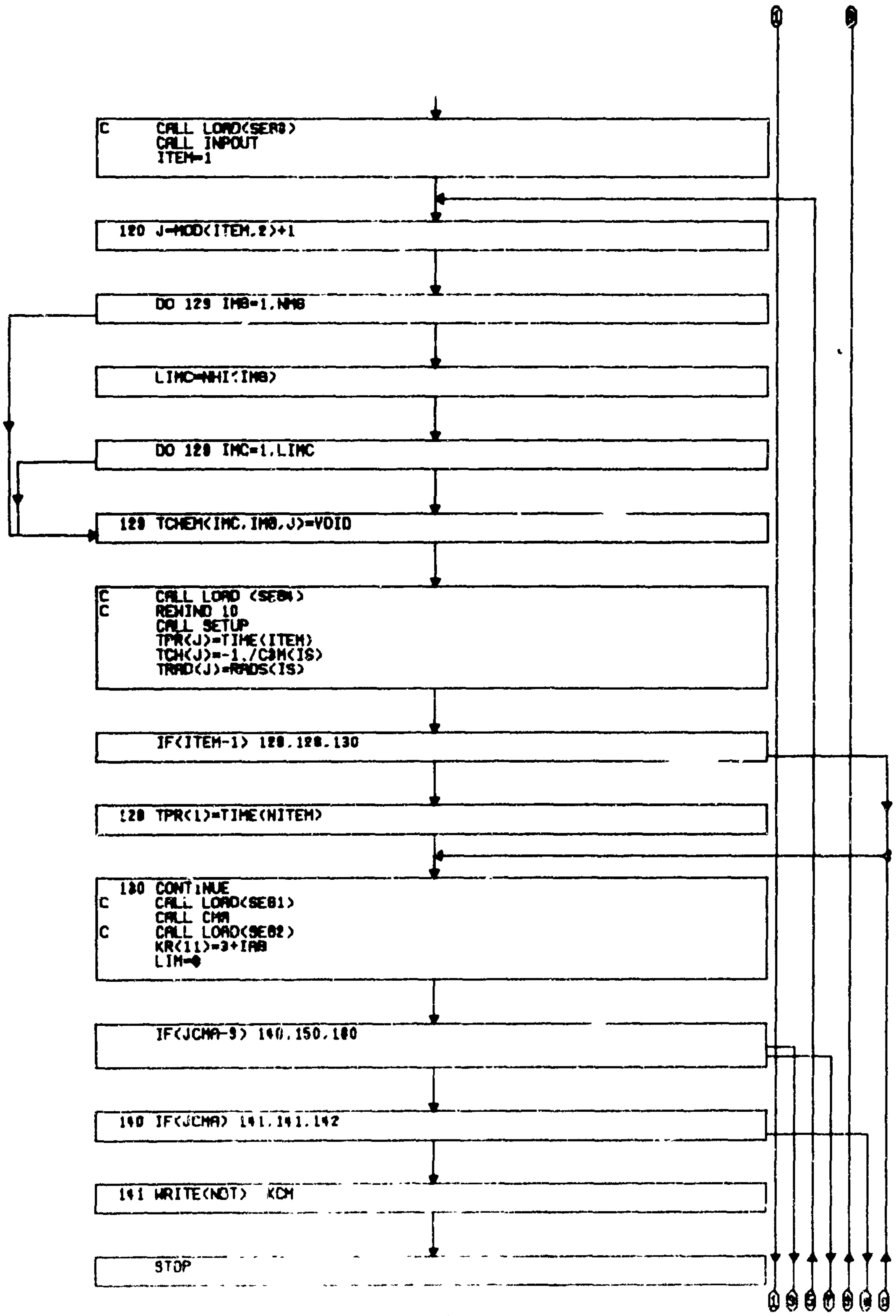
```
      IF (KCM(10) - 2) 102,100,100
```

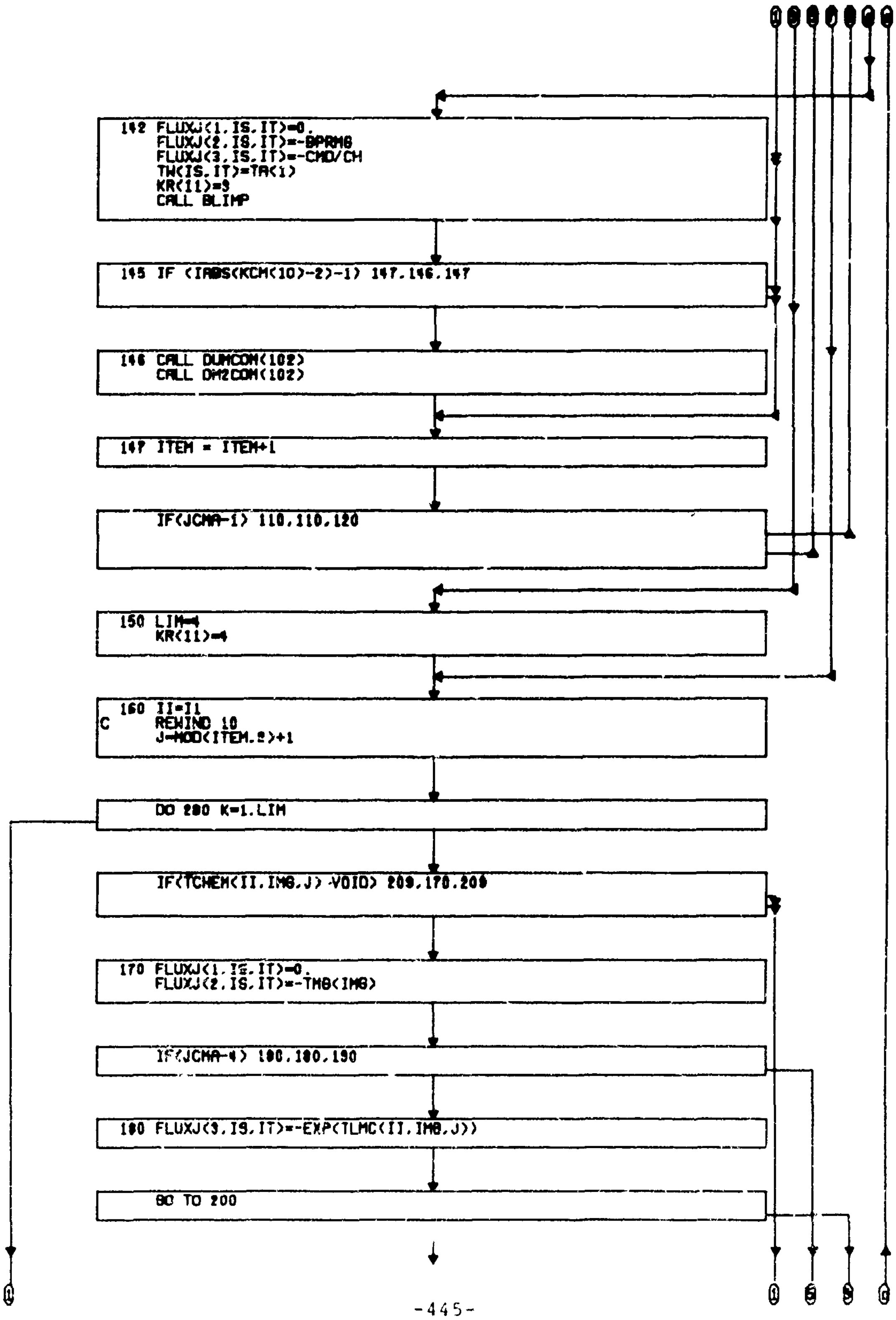
```
C     RESTART
```

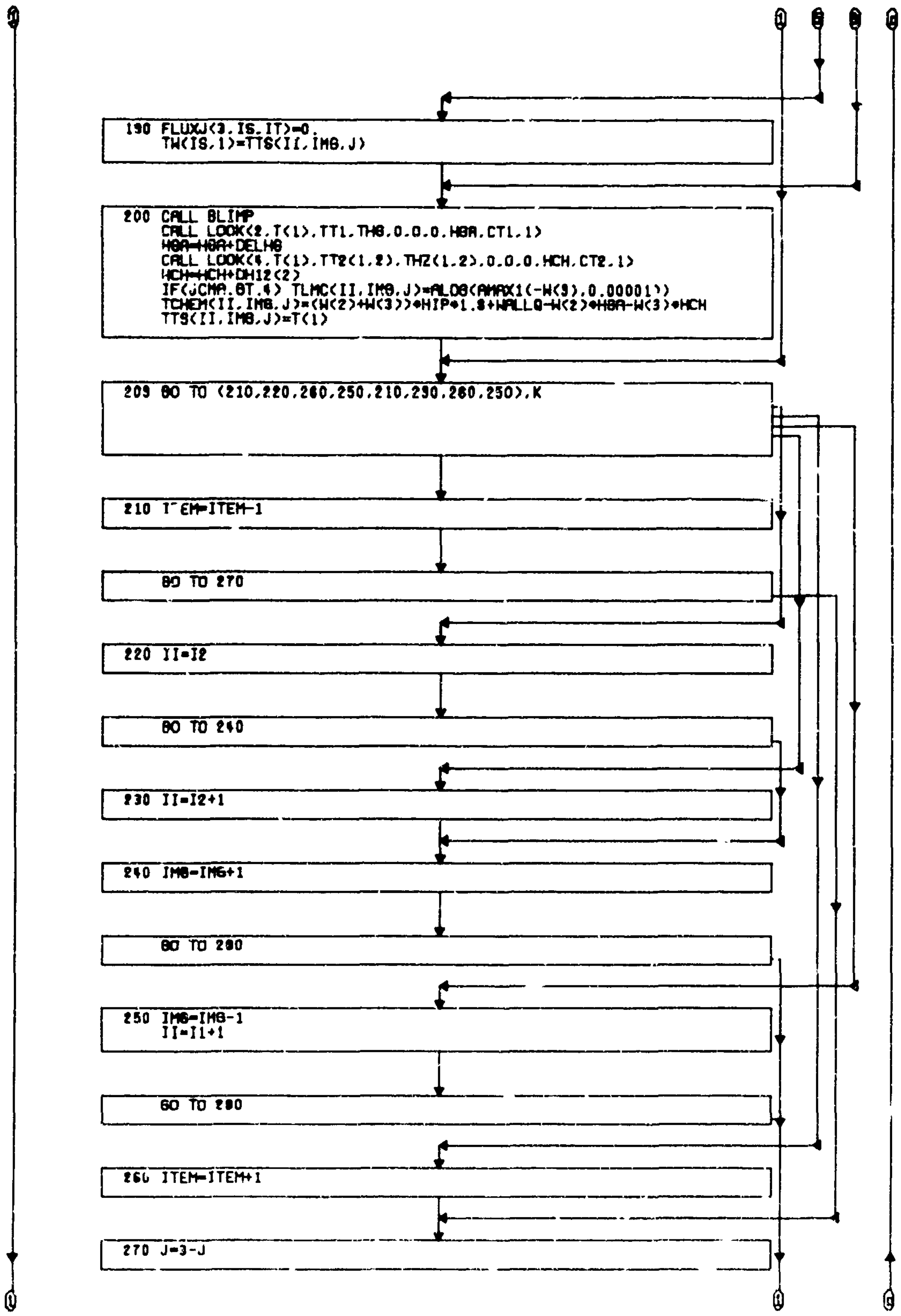
```
  100 NBT=13
```

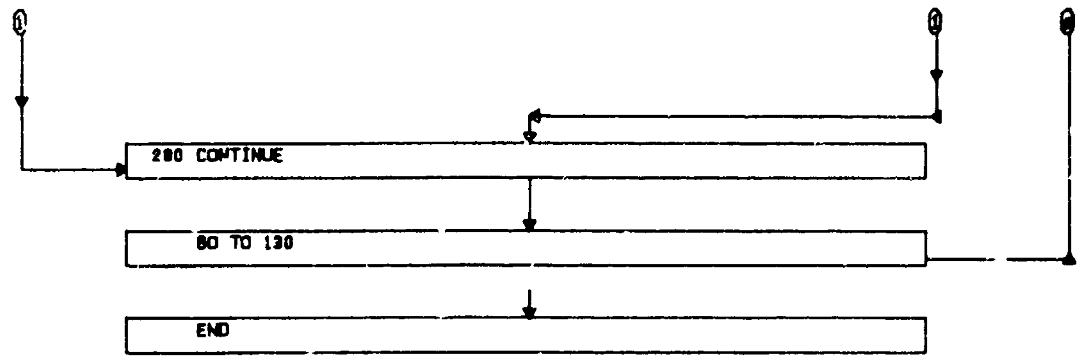
```
      DO 107 IRW=1,2
```


LIM=((IS-IRW+2)/2-1)*NITEM+ITEM-MOD(IS-1+IRW,2)
IF(LIM) 107,107,109
109 DO 108 I=1,LIM
108 READ(NBT) HSTEQV
107 NBT=14
IRW=101
LIM = (IS-1)*NITEM + ITEM
102 DO 103 I = 1,LIM
CALL DUMCOM(IRW)
103 CALL DM2COM(IRW)
IF(IRW) 104,104,147
104 NS=1
IT=1
105 IS=0
MWE=-1
JCMA=1
110 IS=IS+1
IF (IS-NS) 110,115,105
115 CONTINUE


C CALL LOAD(SEG3)
CALL INPOUT
ITEM=1
120 J=MOD(ITEM,2)+1
DO 129 IMB=1,NMB
LIMC=NHI(IMB)
DO 128 IMC=1,LIMC
128 TCHEM(IMC,IMB,J)=VOID
C CALL LOAD (SEG4)
C REWIND 10
CALL SETUP
TPR(J)=TIME(ITEM)
TCH(J)=-1./C3M(IS)
TRAD(J)=RADS(IS)
IF(ITEM-1) 128,128,130
128 TPR(1)=TIME(NITEM)
130 CONTINUE
C CALL LOAD(SEG1)
CALL CMA
C CALL LOAD(SEG2)
KR(11)=3+IAB
LIM=0
IF(JCMA-9) 140,150,180
140 IF(JCMA) 141,141,142
141 WRITE(NOT) KCM
STOP


142 FLUXJ(1.IS.IT)=0.
FLUXJ(2.IS.IT)=-BPRMB
FLUXJ(3.IS.IT)=-CMD/CH
TW(IS.IT)=TA(1)
KR(11)=3
CALL BLIMP
145 IF (IABS(KCM(10)-2)-1) 147.146.147
146 CALL DUMCOM(102)
CALL DM2COM(102)
147 ITEM = ITEM+1
IF(JCMA-1) 110.110.120
150 LIM=4
KR(11)=4
160 II=I1
C
REWIND 10
J=MOD(ITEM.2)+1
DO 200 K=1.LIM
IF(TCHEM(II.IMG.J) -VOID) 209.170.209
170 FLUXJ(1.IS.IT)=0.
FLUXJ(2.IS.IT)=-TMB(IMG)
IF(JCMA-4) 180.180.190
180 FLUXJ(3.IS.IT)=-EXP(TLMC(II.IMB.J))
GO TO 200


190 FLUXJ(3,IS,IT)=0.
TW(IS,1)=TTS(II,IMG,J)
200 CALL BLIMP
CALL LOOK(2,T(1),TT1,THG,0,0,0,HGA,CT1,1)
HGA=HGA+DELHG
CALL LOOK(4,T(1),TT2(1,2),THZ(1,2),0,0,0,HCH,CT2,1)
HCH=HCH+DH12(2)
IF(JCMA.GT.4) TLMC(II,IMG,J)=ALOG(AMAX1(-W(3),0.00001))
TCHEM(II,IMG,J)=(W(2)+W(3))*HIP*1.8+WALLQ-W(2)*HGA-W(3)*HCH
TTS(II,IMG,J)=T(1)
209 GO TO (210,220,260,250,210,230,260,250),K
210 ITEM=ITEM-1
GO TO 270
220 II=I2
GO TO 240
230 II=I2+1
240 IMG=IMG+1
GO TO 280
250 IMG=IMG-1
II=I1+1
GO TO 280
260 ITEM=ITEM+1
270 J=3-J


280 CONTINUE
GO TO 130
END

b. Subroutine DUMCOM (ICK) - B01A

(1) Function

Contains all BLIMP commons with their maximum lengths. This routine is to be loaded first on those machines requiring such a feature. Called by CABLE.

ICK = 101 when restaring and reading dumped commons

= 102 when dumping commons to tape.

(2) Listing

```
CH01A
      SUBROUTINE SUMCOM(ICK)
      COMMON/BLOCOM/ MOA( 71),  MOM( 71),NSPEC,FR( 71,15),W(3),LEF(10)
     1,LEFS(10),PIEASE,LEFW(10)
      COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IX
      COMMON/COECOM/                 C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C1
     1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,C
     232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C4
     3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,C
     465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C8
     5,C82,C83,C84,C85,C86,C87,C88
      COMMON/COECOM/ CK1( 8),CK2( 8),CK3( 8),CK4( 8),CK5( 8),CK6( 8)
     1,CK7( 8),CK8( 8),CK9( 8),CK10( 8),CK11( 8),CK12( 8),CK13( 8)
     2,CK14( 8),CK15( 6),CK16( 8),CK17( 8),CK18( 8),CK19( 8),CK20( 8)
     3,CK21( 8),CK22( 8),CKK1( 9, 8),CKK2( 8, 8),XM(5),XC(5),XSP(5, 9)
     4,CKK3( 8, 8)
      COMMON/CRPCOM/HCARB,EMIS,STEF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMIST
     1,HPG,ASU(3),DSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(40),ISU
      COMMON/EDGCOM/              PF(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,
     1UF(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90
     2 ,DSIP(40),IDSIP,TTVC,TVCC(40)
      COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,
     1EPSA(15),EPS1,EL(15),DPI(15,2),DLI(153),DEPS(153),DEPC,TREF,RETR
      COMMON/EQPCOM/  RB( 71,2),RC( 71,2),RD( 71,2),RE( 71,2),RF( 71,2),
     1 TU( 71,2),FF( 71),FFA,IFC( 71),ATA(10),ATB(10),ATC(10),WAT(10),
     2 MAT(10),IR(10),IZ,KZ(10),LAMI( 71),P,Z,TK(10, 7),VN( 71),
     3 VNU( 71,10),ITFF,KR2,HCH,NCV,RM,WTM( 71),YYY( 71),VW( 71),GG( 71)
     4 ,TG(10, 7),EPOVRK,SIGMA,RASMOL
      COMMON/EGTCOM/SIF,HIP,EEL,EENL,FLIQ,CPF,IRE,IER,AA,IITS,IN,IL,IIT,
     1 MODE,HMELT,SMELT,TMAX,TMIN,MFLT,SUMN,SUML,WS,WBS,BX,ISP2,ISPG,
     2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HHG,
     3 CCPG,TTMIN,TTMAX,L2,L3,IB(11),EB(10),EBL(10),A(16,16),BB(16),
     4 IP( 71),ALP(10),FNU(10),GAMH(10),GAMF(10),SLAM(10),DY( 71),RVS,
     5 CP( 71),HH( 71),SB( 71),TC( 71),VLNK( 71),E( 71),PNUB(10),
     6 BC(10),BLNK(10),BY(10),IBC(10),BE(10),JZ( 4)
      COMMON/ERRCOM/FLE( 43),GLE(30),SPLE(30, 8),ELA(313),FLEM,GLEM
     1,SPLEM( 8),ELM(14),ELMM,IFLM,IGLM,ISPLM( 8),NELM,ILMM,DFL(43)
     2,DGL(30),DSPL(30, 8),FNLE(18),GNLE(15),SPNLE(15, 8),ENL(153)
     3,FNLEM,GNLEM,SPNLEM( 8),              ENLMM,IFNLM,IGNLM,ISPNLM( 8)
     4,MENLM,INLMM,DFNL(18),DGNL(15),DSPNL(15, 8),DRNL(10)
      COMMON/ETACOM/ETA(15),DETA(15),CSQ(14),DCU(14),B1(14),B2(14)
     1,LAR(153),BA1(43,18),BA2(30,15)
      COMMON/FLPCOM/TXI(2),TUE(2),TRHOE(2),TTE(2),TVMUE(2),TMAT(566,2)
     2,THF(15,2),LEFT(10,2),TPE(2),TRADS(2),TDSIP(2),KQT(2)
      COMMON/FLXCOM/DELQW,DELJW( 8),DQNL(153),DJNL(153, 8),WALLQ
     1,WALLJ( 8),QW,VJKW( 9),TPWALL
      COMMON/MISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8
     1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2
     2,C3M(40),BETAM(40)
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,N
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15)
     2,R(8),         MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40)
     3,KAUXO,JTIME,JSPEC,MD(3)
      COMMON/KINCOM/MT,FKF(10),EAK(10),EXK(10),PMU(10,10),RMU(10,10),
     1 RKPT(10),PKP(10),PKR(10),RAT(10),RSIG(10),MA(10),LL(10),PMR(10),
     2 PRMU(10,10),EESE(10)
      COMMON/NONCOM/AM(153,153),DVNL(153),TCW,
     1VLNKW,DLPH( 9),DLPK( 8, 9),DTHW,DTKW( 8),FLUXJB( 9)
```

```
      COMMON/OUTCOM/Y(15),RES,DELST,THENGY,THMOM,CH,BLOW,SHEAR,CF,SHAPE B01A  59
     1 ,CH( 9),THELEM( 9)                                               B01A  60
      COMMON/PH COM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) B01A  61
     1,RNOSE,VKAP,NDISC,IDISC(40),MSD(10),MSD(10),ITF( 50),IPRE,RADNO,  B01A  62
     2CONF,RADFL( 50),RADR(40),RADS(40),IRAD                            B01A  63
      COMMON/PRPCOM/PR(15),T(15),RHO(15),SC(15),CAPC(15),QR(15),H(15)   B01A  64
     1,CPBAR(15),VMW(15),PHIK(15, 8),DRHOH,DRHOK( 8),ZK( 8),DZKH( 8),  DB01A  65
     2H 3K( 8),DMU4K( 8),DTK( 8),CPHIKH( 8),DPRK( 8),DSCK( 8),DCAPCK( 8)B01A  66
     3,DHTILK( 8),DQRK( 8),DCPBK( 8),DCPTK( 8),DMU12K( 8),DZKK( 8, 8)   B01A  67
     4,CPHIKK( 8, 8),      DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL   B01A  68
     5,VMU3,CTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(15),  RHOP B01A  69
     6(15),PHIKP(15),HP,TP,ZKP( 8),VMU3P,VMU4P,HTILP,CRHO(14),GMR(15)   B01A  70
      COMMON/STTCOM/GAM1,PRDUM,PRA,PRB,PRC,PRD,VMUA,VMUB,VMUC,VMUD,NC,  B01A  71
     1 FLD(6,3),VMWD                                                    B01A  72
      COMMON/TEMCOM/SPDUM( 8),DER(40),DUMM1(15),SLOPE(15),REDUM(15)     B01A  73
     1,SDUM1(40),SDUM2(40),FWDUM(40),XICON(40),FWCON(40),FWINIT( 1)     B01A  74
     2,XIINIT( 1),DUDS( 40)                                             B01A  75
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    B01A  76
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         B01A  77
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      B01A  78
      EQUIVALENCE (FLPEQV,TXI),(BLQEQV,MOA),(BUMEQV,BUMP),(COEEQV,C5),
     1(CONEQV,CK1),(CRBEQV,HCARB),(EDGEQV,PF),(EQPEQV,RB),(EPSEQV,ELCON)
     2,(KINEQV,NT),(EQTEQV,SIP),(ERREQV,FLE),(ETAEQV,ETA),(HISEQV,C1),
     3 (INTEQV,KIN),(NONEQV,AM),(PRMEQV,TIME),(PRPEQV,PR),(STTEQV,GAM1),
     4 (TEMEQV,SPDUM),(VAREQV,F),(WALEQV,FW),(FLXEQV,DELQW),(OUTEQV,Y)
      DIMENSION BLQEQV( 1242),BUMEQV(   10),COEEQV(   84),CONEQV(  423)
     1          ,CRBEQV(   67),EDGEQV(  649),EPSEQV(  381),EQPEQV( 2352)       *NEW
     2          ,EQTEQV( 1033),ERREQV( 1468),ETAEQV( 1463),FLPEQV( 1200)       *NEW
     3          ,FLXEQV( 1406),HISEQV( 1171),INTEQV(  128),KINEQV(  421)       *NEW
     4          ,NONEQV(23663),OUTEQV(   42),PRMEQV(  517),PRPEQV(  608)       *NEW
     5          ,STTEQV(   30),TEMEQV(  335),VAREQV(  511),WALEQV(  606)       *NEW
      DATA ATA(1),ATB(1),ATC(1)/4H    ,4H    ,4H    /                          **-5
      IF (ICK-101) 70,10,40
   10 READ( 12 )  FLPEQV,BLQEQV,BUMEQV,COEEQV,CONEQV,CRBEQV,EPSEQV,
     1            EDGEQV, EQPEQV, KINEQV, EQTEQV, ERREQV, ETAEQV,
     2            FLXEQV, HISEQV, INTEQV, NONEQV, OUTEQV, PRMEQV,
     3            PRPEQV, STTEQV, TEMEQV, VAREQV, WALEQV
      GO TO 70
   40 WRITE(12 )  FLPEQV,BLQEQV,BUMEQV,COEEQV,CONEQV,CRBEQV,EPSEQV,
     1            EDGEQV, EQPEQV, KINEQV, EQTEQV, ERREQV, ETAEQV,
     2            FLXEQV, HISEQV, INTEQV, NONEQV, OUTEQV, PRMEQV,
     3            PRPEQV, STTEQV, TEMEQV, VAREQV, WALEQV
   70 CONTINUE
    5 RETURN                                                            C01A 067
      END                                                               C01A 068
```

c. Subroutine DM2COM((ICK) - C018

(1) Function

Contains all CMA commons with their maximum lengths. Called by CABLE.

ICK = 101 when restarting and reading dumped commons.

= 102 when dumping commons to tape.

(2) Listing

```
CC01B                                                                  C01B 001
      SUBROUTINE DM2COM(ICK)                                            C01B 002
      COMMON/CAMCOM/TLMC(20,10,2),TMG(20),TTS(20,10,2),TCHEM(20,10,2),  C01B 003
     1MLO(20),MHI(20),KHI(20),JCMA,IMG,IMC,NMG,                         C01B 004
     2TCH(2),TMH(2),TRAD(2),IAB                                         C01B 005
     3,T12(20,2),THZ(20,2),TT1(30),THG(30),DH12(2),TA(39),DELHG,I1,I2,CHC01B 006
     4,CAD,BPRMG,KCM(10)                                                C01B 007
      EQUIVALENCE (MCLASS,JCMA)                                         C01B 008
      COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)              C01B 009
      COMMON/CMACOM/TEP(20,2), TCP(20, 2),TKP(20, 2)                    C01B 010
     3,CMO(2), DTL(38),DEL(39),SO(20),H(38),RC(38),RA(38),RECORD(36),   C01B 011
     4AREA(38),CMA(38),RAV(38),                                         C01B 012
     5ROA(152),ROB(152),ROC(152),                                       C01B 013
     6    TPI(30),VFZ,CMH,NPR,                                          C01B 014
     7LCT,NPG,II,NBM,NUMN,NL,        DELM,RET,RHORA,RHORB,RHORC,TRA     C01B 015
     8C ,TRACB,TRACC,RHOOA,RHOOB,RHCOC,EA,EB,EC,BA,BB,HC,PSIA,PSIB,PSIC,C01B 016
     9TRACA,PET,PETE,PSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WT C01B 017
      COMMON/CHACOM/EPSW,TRES,                                          C01B 018
     1T AT,GAMA,OMG,NO,FJFH,FJFS,JF,JFHP,JFH,INPUT,      DTHIN,BRP,HCONV,C01B 019
     2I CH,DTHR,NN,NI,NOI,CHCRI,PYCRI,NCON,     NR,TX(30),F1(30),F2(30) C01B 020
      COMMON/SRCP/BF,CMMA,CMMI,DERR,DMIV,EMIV,ERFX,ERRC,ERR,ERRS,I3,I4, C01B 021
     1V M,VRP, IPR,IRA,IRB,IRC,IRD,ITL,PHI,QQ,TABC,TEMP,TSMA,TSMI,TSSQ  C01B 022
      COMMON/SRCP/ TNXT,    DNCP(3),CPE(3),TC(20),VITER(51),EITER(51)   C01B 023
      COMMON/SRCP/ Y2(16),D2(16),Y3(8),D3(8),Y1(2),D1(2)                C01B 024
      COMMON/SRCP/ CPC( 50),CPV( 50),CP( 50),HP ( 50),HC( 50),CV( 50),  C01B 025
     1HAT( 50),ROT( 50),RO( 50),X( 50),ROM( 50),DMDG( 50),RR ( 50),     C01B 026
     2CMG( 50),A( 50),B( 50),C( 50),D( 50),EMO( 50),CNO( 50)            C01B 027
      COMMON/SRCP/BR,    CHZ,     CMDL,     DEDT,DEDTT,DSDTB,DTH,GSMS,HW,  C01B 028
     1HF,     ITS,PRES,QCHEM,QCHEMT,QCOND,QCONDT,QCONV,QCONVT,QRA,QRP,   C01B 029
     2QRPT,RAD,RADT,RSU,SIG,    TSAVE,VF,XP1,ASL                        C01B 030
      COMMON/MISC/        BPRM,CMT,COLD,CP1,CPGAS,CPNL,CZ,DCOT,DECOM,    C01B 031
     1DECOMT,DELCP,DELR,DENOLD,DIRT,DNS,DPDT,DRLCP,DRLC,DRLP,DRL,DROAC, C01B 032
     2DROAT,DROBC,DROBT,DROCC,DROCT,DRODTD,DSDT,DSI,DS,DSS,DTA,DTHC,DTHSC01B 033
     3,DIS,DVB,DZ,EGO,EZ,FACT1,FACT2,FA,FB,FC,FJF,FK,FZ,GSEGR,GSM,GSMT, C01B 034
     4GZ,H1,HAPHB,HFAR,HGAS,HRES,IE,IMIN,I,IS,ISV,ITER,J1,J,KK,K,KT,L,  C01B 035
     5NPR,NLI,NLM,N,NZ,O,PGPU,PGPUT,POLD,POW,QLOSS,QLOSST,RD,RO1,ROOZ,SAC01B 036
     6,SOEGR,TAS,TB,TERM1,TERM2,TERM3,THDS,TH,THPRT,TN,TOP1,TOP2,TOP3,T,C01B 037
     7TT,VOL,X1                                                         C01B 038
      EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)                   C01B 039
      DIMENSION CAMEQV(1478),LOOEQV( 73),CMAEQV(1125),SRCEQV(1237),
     1          MISEQV(101)
      EQUIVALENCE (CAMEQV,TLMC),(LOOEQV,KOUT),(CMAEQV,TEP),
     1            (SRCEQV,BF),(MISEQV,BPRM)
      IF (ICK - 101) 40,10,20
   10 READ ( 12 ) CAMEQV, LOOEQV, CMAEQV, SRCEQV, MISEQV
      GO TO 40
   20 WRITE( 12 ) CAMEQV, LOOEQV, CMAEQV, SRCEQV, MISEQV
   40 RETURN
      END                                                               C01B 041
```

d. Subroutine BLIMP - C02A

(1) Function

Similar to BLIMP main program. Called by CABLE. Calls ITERAT, OUTPUT.

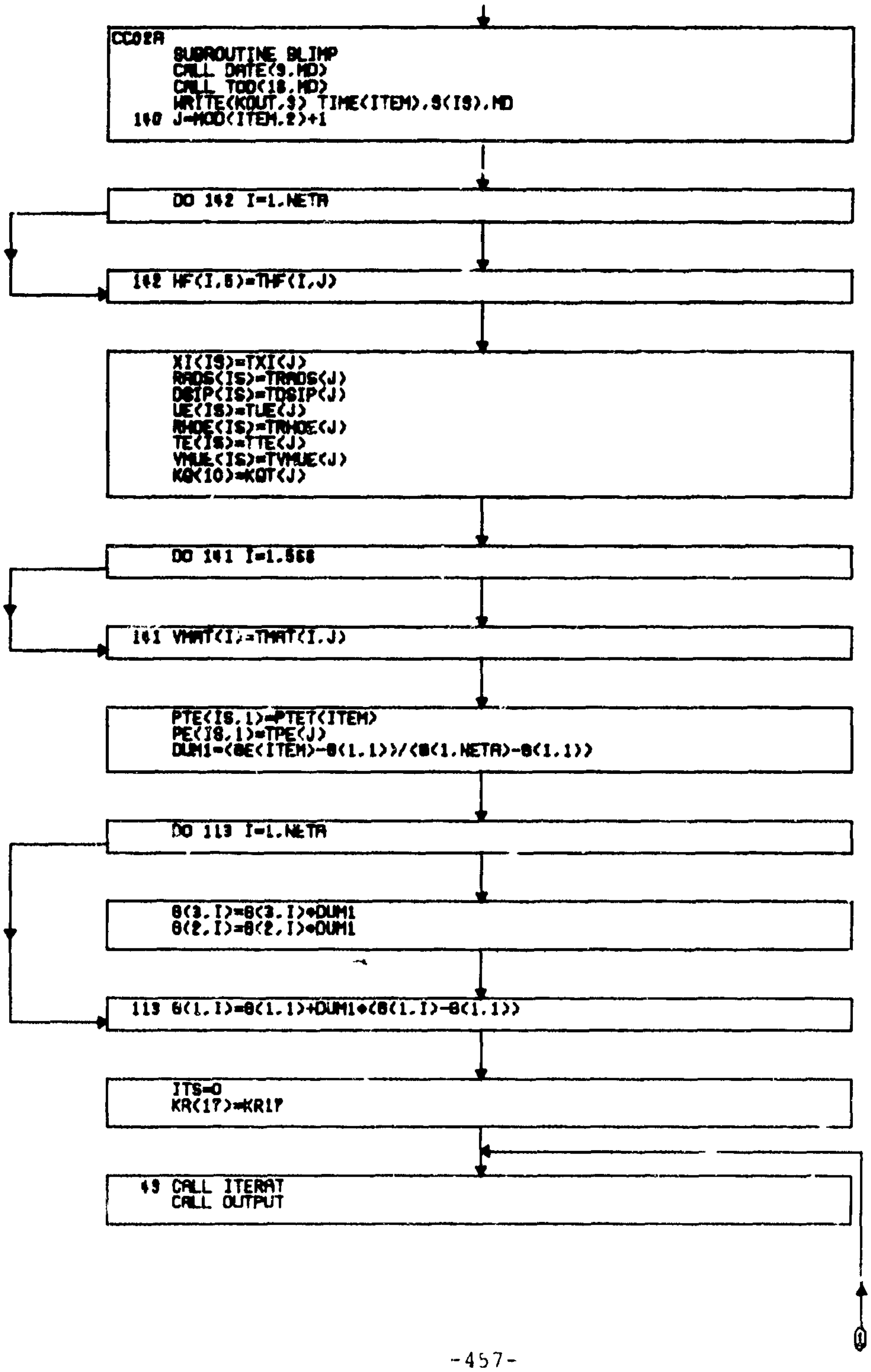
(2) **Listing**

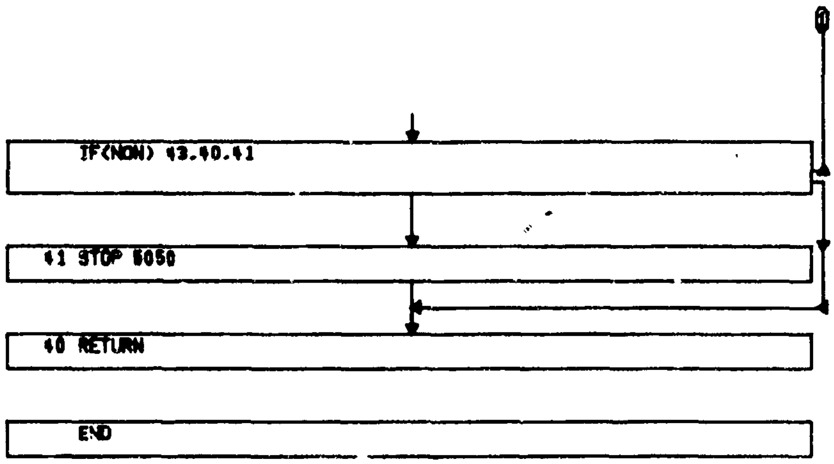
```
CC02A                                                                   C02A 001
      SUBROUTINE BLIMP                                                  C02A 002
      DIMENSION HIST1(605),HIST2(607),HIST3(511),VMAT(566),HIST4(600)   C02A 003*NEW
      COMMON/BLNCOM/ MOA( 71),  MOR( 71),NSPEC,FR( 71,15),W(3),LEF(10) C02A    4*NEW
     1,LEFS(10),PIEASE,LEFW(10)                                         C02A    5*NEW
      COMMON/EDGCOM/           PE(40, 1),PTE(40, 1),SPE( 8,40, 1),DUES,C02A    6*NEW
     1UE(40),RHOE(40),VMUE(40),TE(40),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90   C02A    7*NEW
     2 ,DSIP(40),IDSIP,TTVC,TVCC(40)                                    C02A    8*NEW
      COMMON/FLPCOM/TXI(2),TUE(2),TRHOE(2),TTE(2),TVMUE(2),TMAT(566,2)  C02A    9*NEW
     2,THF(15,2),LEFT(10,2),TPE(2),TRADS(2),TDSIP(2),KQT(2)             C02A   10*NEW
      COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,14),ZG(4,14),ZSP(4,14, 8C02A   11*NEW
     1 ),XI(40),HF(15,5),HG(15,3),HSP(15,3, 8),HALPH,HUE,HHUE,HFW,DLX2  C02A   12*NEW
     2,E3M(40),HETAM(40)                                                C02A   13*NEW
      COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,NC02A   14*NEW
     1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15) C02A   15*NEW
     2,P(8),       MWE,NON,K9(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(40) C02A   16*NEW
     3,KAUXO,JTIME,JSPEC,MD(3)                                          C02A   17*NEW
      COMMON/PRMCOM/TIME( 50),PRE(40),PTET( 50),GE( 50),S(40),ROKAP(40) C02A   18*NEW
     1,RNOSE,VKAP,NDISC,IDISC(40),NSD(10),MSD(10),ITF( 50),IPRE,RADNO,  C02A   19*NEW
     2CONF,RADFL( 50),RADR(40),RADS(40),IRAD                            C02A   20*NEW
      COMMON/VARCOM/F(4,15),G(3,15),SP(3,15, 9),ALPH                    C02A   21*NEW
      COMMON/WALCOM/FW(40, 1),TW(40, 1),HW(40, 1),SPW( 8,40, 1)         C02A   22*NEW
     1,RHOVW(40, 1),FLUXJ( 3,40, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ      C02A   23*NEW
      EQUIVALENCE(HIST1,XI),(HIST2, PE),(HIST3,F),(VMAT,C1),(HIST4,FW)  C02A 008*-21
    3 FORMAT(1H17X4HTIMEE12.5,35H SECONDS - - - STREAMWISE DIMENSIONE12C02A 023
     1.5,11H FEET - - - 3A6)
      CALL DATE(9,MD)
      CALL TOD(18,MD)
      WRITE(KOUT,3) TIME(ITEM),S(IS),MD
  140 J=MOD(ITEM,2)+1                                                   C02A 027
      DO 142 I=1,NETA                                                   C02A 028
  142 HF(I,5)=THF(I,J)                                                  C02A 029
      XI(IS)=TXI(J)                                                     C02A 030
      RADS(IS)=TRADS(J)
      DSIP(IS)=TDSIP(J)
      UE(IS)=TUE(J)                                                     C02A 031
      RHOE(IS)=TRHOE(J)                                                 C02A 032
      TE(IS)=TTE(J)                                                     C02A 033
      VMUE(IS)=TVMUE(J)                                                 C02A 034
      KR(13)=KQT(J)
      DO 141 I=1,566                                                    C02A 035*NEW
  141 VMAT(I)=TMAT(I,J)                                                 C02A 036**-1
      PTE(IS,1)=PTET(ITEM)                                              C02A 037
      PE(IS,1)=TPE(J)                                                   C02A 038
      DUM1=(GE(ITEM)-G(1,1))/(G(1,NETA)-G(1,1))                         C02A 039
      DO 113 I=1,NETA                                                   C02A 040
      G(3,I)=G(3,I)*DUM1                                                C02A 041
      G(2,I)=G(2,I)*DUM1                                                C02A 042
  113 G(1,I)=G(1,1)+DUM1*(G(1,I)-G(1,1))                                C02A 043
      ITS=1                                                             C02A 044
      KR(17)=KR17                                                       C02A 045
   43 CALL ITERAT                                                       C02A 046
      CALL OUTPUT                                                       C02A 047
      IF(NON) 43,40,41
   41 STOP 5C53
   40 RETURN                                                            C02A 049
      END                                                               C02A 050
```

```
      104 K917=KR(17)                                                   C03A 045
      154 IF(IS+ITEM-2) 105,105,1572
     1572 IF(KR(3)) 1570,1577,1570
     1570 IF(KR(6)-1) 1571,1571,1576
     1571 IF(IS-1) 1577,1577,1576
     1576 DO 1573 K=1,NSP                                               C03A 048
          IF(LEF(K)-1) 1573,1575,1573                                   C03A 049
     1575 LEF(K)=2                                                      C03A 050
     1573 CONTINUE                                                      C03A 051
     1577 IF(NITEM-1) 1574,107,1574                                     C03A 052
     1574 WRITE(NBT)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KQ(10)
          IF(ITEM-1) 157,156,157                                        C03A 054
      156 IDUM=NBT                                                      C03A 055
          NBT=NBT2                                                      C03A 056
          NBT2=IDUM                                                     C03A 057
          DO 153 I=1,NITEM
      153 BACKSPACE NBT2
          GO TO 155                                                     C03A 060
      157 IF(IS-1) 105,105,155
      155 READ(NBT2)HIST1,HIST2,HIST3,HIST4,W,LEF,RADS,KQ(10)
          GO TO 107                                                     C03A 063
C     INITIAL GUESSES FOR PRINCIPAL DEPENDENT VARIABLES, CALCULATE(KR(2)C03A 066
C     =0), INPUT(KR(2)=1), OR USE VALUES FROM FROM PREVIOUS CASE(KR(2)  C03A 067
C     =2), NOTE..LATTER REQUIRES SAME ETA VALUES AND SAME SPECIES, ITS  C03A 068
C     UTILITY IS FOR REPEATED SIMILARITY SOLUTIONS, IT OBVIOUSLY  CANNOTC03A 069
C     BE USED FOR FIRST CASE.                                           C03A 070
      105 CALL FIRSTG                                                   C03A 071
          IF(TIME(1)) 1051,1052,1052
     1051 ITAB=ABS(TIME(ITEM))
          WRITE(KOUT,4) ITAB, MD
          GO TO 106
     1052 WRITE(KOUT,2) TIME(ITEM),MD
      106 IF(KR(7))204,204,203
      203 IF(KR(12).NE.1) CALL STATEN
          GO TO 202
      204 IF(KR(12).NE.1) CALL INPUT(PTET(1))
      202 CALL REFCON
          IF(KQ(9).NE.0) CALL TRANCR(1)                                       *NEW
          KR(12)=1                                                      C03A 076**-1
          IS=1                                                          C03A 077
      107 DO 1262 I=1,NSP
          IF(IS.EQ.1.AND.LEF(I).EQ.2) LEF(I)=1
     1262 LEFT(I,J)=LEF(I)                                              C03A 080
C-----COMPUTE HISTORIC INFORMATION
          CALL HISTXI
          IF(TIME(1)) 1053,1054,1054
     1053 ITAB=ABS(TIME(ITEM))
          WRITE(KOUT,5) ITAB, S(IS), MD
          GO TO 126
     1054 WRITE(KOUT,3)TIME(ITEM),S(IS),MD
      126 DO 1261 I=1,NETA
     1261 THF(I,J)=HF(I,3)                                              C03A 085
          TXI(J)=XI(IS)                                                 C03A 086
          TRADS(J)=RADS(IS)
          TDSIP(J)=DSIP(IS)
          TUE(J)=UE(IS)                                                 C03A 087
          TRHOE(J)=RHOE(IS)                                             C03A 088
          TTE(J)=TE(IS)                                                 C03A 089
          KQT(J)=KQ(10)
          TVMUE(J)=VMUE(IS)                                             C03A 090
```

```
      DO 184 I=1,566                                                    C03A 091*NEW
  184 TMAT(I,J)=VMAT(I)                                                 C03A 092**-1
      TPE(J)=PE(IS,1)                                                   C03A 093
      MVE=0                                                             C03A 094
C     START OF ITERATION LOOP                                           C03A 095
  158 ITS=0                                                             C03A 096
      KR(17)=KR17                                                       C03A 097
  159 RETURN                                                            C03A 098
      END                                                               C03A 099
```

(3) Flow Chart


CC02A
SUBROUTINE BLIMP
CALL DATE(9,MD)
CALL TOD(18,MD)
WRITE(KOUT,3) TIME(ITEM),S(IS),MD
140 J=MOD(ITEM,2)+1
DO 142 I=1,NETA
142 HF(I,5)=THF(I,J)
XI(IS)=TXI(J)
RADS(IS)=TRADS(J)
DSIP(IS)=TDSIP(J)
UE(IS)=TUE(J)
RHOE(IS)=TRHOE(J)
TE(IS)=TTE(J)
VMUE(IS)=TVMUE(J)
KQ(10)=KQT(J)
DO 141 I=1,568
141 VMAT(I)=TMAT(I,J)
PTE(IS,1)=PTET(ITEM)
PE(IS,1)=TPE(J)
DUM1=(BE(ITEM)-B(1,1))/(B(1,NETA)-B(1,1))
DO 113 I=1,NETA
B(3,I)=B(3,I)*DUM1
B(2,I)=B(2,I)*DUM1
113 B(1,I)=B(1,1)+DUM1*(B(1,I)-B(1,1))
ITS=0
KR(17)=KR17
43 CALL ITERAT
CALL OUTPUT
1


0
IF(NON) 43.40.41
41 STOP 5050
40 RETURN
END

e. Subroutine CMA - B31A

(1) Function

This is the charring material ablation program of reference 2. It is the controlling program for CABLE, calling for BLIMP solutions when necessary. Called by CABLE. Calls LCOUNT, LOOK, OGLE, SLOPQ, SBCPKG.

(2) Listing

```
C B31A
      SUBROUTINE CMA
C        TWO MOVING BOUNDARY INTERNAL CONDUCTION PACKAGE
C         AEROTHERM CORPORATION     RM KENDALL  C MOYER
      COMMON/CAMCOM/TLMC(20,10,2),THG(20),TTS(20,10,2),TCHEM(20,10,2),
     1MLO(20),NHI(20),KHI(20),JCMA,IMG,IMC,NMG,
     2TCH(2),TPH(2),TRAD(2),IAB
     3,TT2(20,2),THZ(20,2),TTJ(30),THG(30),DH12(2),TA(39),DELHG,I1,I2,CH
     4,CMD,BPRHG,KCM(10)
      EQUIVALENCE (NCLASS,JCMA)
      COMMON/LOOCOM/KOUT,IEX,DEW VR,IPI(23),ILO(23),IR(23)
      COMMON/TACOM/TEF(20,2), TCP(20, 2),TKP(20, 2)
     3,FMO(2),WTL(38),DCL(39),SO(20),H(38),RC(38),RA(38),RECORD(36),
     4AREA(38),SMA(38),RAV(38),
     5RRA(152),ROR(152),ROC(152),
     6    TPI(30),VFZ,CMH,NPR,
     7LPT,NPS,II,NBM,NUMN,NL,       RELM,RFT,RHORA,RHORB,RHORC,TRA
     8CA,TRACB,TRACC,RHOA,RHOB,RHOC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,
     9TRACM,PCT,PETE,RSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WT
      COMMON/CHACOM/EPS ,TRES,
     1THWT,GAMA,OMG,NC,FJF ,FJFS,JF,JFHP,JFH,INPUT,      DTHIN,ERP,HCONV,
     2PINCH,DTHR,NN,MI,JOI,CHCRI,PYCRI,NCON,     NR,TX(30),F1(30),F2(30)
      COMMON/SHCP/BF,CMMA,CMMI,DERR,DMIV,EMIV,ERFX,ERRC,ERR,FRRS,I3,I4,
     1VRM,VRP, IPP,IRA,IRB,IRC,IRD,ITL,PMI,QQ,TABC,TEMP,TSMA,TSMI,TSS3
      COMMON/SHCP/ TNXT,    DNCP(3),CPE(3),TO(20),VITER(51),EITER(51)
      COMMON/SHCP/ Y2(16),D2(16),Y3(8),D3(8),Y1(2),D1(2)
      COMMON/SHCP/ CPC( 50),CPV( 50),CP( 50),HP ( 50),HC( 50),CN( 50),
     1HV( 50),ROT( 50),RO( 50),X( 50),ROR( 50),DMDG( 50),RR ( 50),
     2C C( 50) A( 50),B( 50),C( 50),D( 50),FMO( 50),CNO( 50)
      COMMON/SHCP/BR,    CHZ,     CMDL,     DEDT,DEDTT,DSDTB,DTH,GSMS,HW,
     1HF,     ITS,FRES,QCHEM,QCHEMT,QCOND,QCONDT,QCONV,QCONVT,QRA,QRP,
     2QRPT,RAD,RADT,RSU,SIG,    TSAVE,VF,XP1,ASU
      COMMON/MISC/         BPRM,CMT,COLD,CP1,CPGAS,CPNL,CZ,DCDT,DECOM,
     1DECOMT,DELCP,DELR,DENOLD,DIDT,DNS,DPDT,DRLCP,DRLC,DRLP,DRL,DROAC,
     2DROAT,DROBC,DROBT,DROCC,DROCT,DRODTO,DSDT,DSI,DS,DSS,DTA,DTHC,DTHS
     3,DTS,DVR,DZ,EGO,EZ,FACT1,FACT2,FA,FB,FC,FJF,FK,FZ,GSEGR,GSM,GSMT,
     4GT,H1,HAPHB,HBAR,HGAS,HRES,IE,IMIN,I,IS,ISV,ITER,J1,J,KK,K,KT,L,
     5NOR,NLI,NLM,N,NZ,O,PGPU,PGPUT,POLD,POW,QLOSS,QLOSST,RD,RO1,ROOZ,S
     6,SOEGR,TAS,TB,TERM1,TERM2,TERM3,THDS,TH,THPRT,TN,TOP1,TOP2,TOP3,T,
     7TT,VOL,X1
      EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)
  542 FORMAT(/33X14H----OUTPUT----)
  543 FORMAT(//6X14(2H- )F11.4,9H SECONDS 14(2H -))
  544 FORMAT(6X,4HTIME,2X 7HSURF,2X,4HPROB,2X,7HSURFACE,5X,6HH WALL,
     14X,6HH EDGE,6X,13HHE    TEFF,4X,6HCH/CHO/6X,4HSTEP,2X,4HITER,2X,4H
     2PRIN,2X,8HRAD (IN),3X,   T (LB) 2X,8H(BTU/LB),3X,14H(LB/SQ FT-SE
     3))
  545 FORMAT(6X,I4,2I6,F10.4,F1 .2,F10.2,F12.4,7X,F8.5/1H )
  546 FORMAT(33X,20H---ABLATION RATES---)
  547 FORMAT(8X,7HB PRIME,3X,9HB PRIME G  ,1  M DOT CHAR,3X,9HM DOT GAS
     18X,6HM CHAR,7X,5HM GAS/34X,14H(LB/SQ FT-SEC),  1X,15H(LB/ORIG SQ FT
     2))
  548 FORMAT(8X,F8.5,2X,F8.5,4(3X,F10.6)/1H )
 5480 FORMAT(27X,32H---RECESSIONS/RECESSION RATES---/
     133X,19H(IN)        (IN/SEC)/
     2  16X,7HSURFACE,16X,6HCHAR (,F4.2,1H),11X,11HPYROLYSIS (,F4.2,1H))
 5481 FORMAT(5X,3(4X,F10.7,1H/,F9.7)/1H )
 5482 FORMAT(27X,31H---SURFACE ENERGY FLUX TERMS---/25X,37HCURRENT RATES
```

```
     1 (BTU/SQ FT SURFACE-SEC)/24X,38HAND INTEGRATED VALUES (BTU/ORIG SQ
     2 FT)/
     3      13X,10HCONVECTED ,4X,10H RADIATED ,4X,10H RADIATED ,4X,10H CHE
     4MICAL ,4X,10HCONDUCTION/17X,2HIN,12X,2HIN,11X,3HOUT,8X,10HGENERATI
     5ON,7X,4HAWAY)
 5483 FORMAT (6X,4HRATE,3X,5(E10.3,4X)/6X,5HTOTAL,2X,5(E10.3,4X)/1H )
 5484 FORMAT(3,X,27H---INTERIOR ENERGY TERMS---/25X,37HCURRENT RATES (BT
     1U/SQ FT SURFACE-SEC)/24X,38HAND INTEGRATED VALUES (BTU/ORIG SQ FT)
     2/
     3          13X,9HPYROL GAS,7X,6HDECOMP,6X,10HCONVECTION,6X,7HSTORAGE,
     47X,7HLOSS AT/14X,7HPICK UP,6X,10HABSORPTION,3X,11HWITH SOLIDS,5X,
     58HIN SOLID,6X,9HREAR FACE)
 5485 FORMAT (6X,4HRATE,3X,5(E10.3,4X)/6X,5HTOTAL,2X,5(E10.3,4X)/1H )
  549 FORMAT (6X8HNODE MAT3X4HTEMP3X7HDENSITY3X8HENTHALPY2X8HNODE MAT3X4
     1HTEMP3X7HDENSITY3X8HENTHALPY/15X7H(DEG R)11H (LB/CU FT)9H (BTU/LB)
     211X7H(DEG R)11H (LB/CU FT)9H (BTU/LB))
 5490 FORMAT(6X,8HNODE MAT,3X,4HTEMP,3X,7HDENSITY,2X,9HCOND(BTU/,2X,8HNO
     1DE MAT,3X,4HTEMP,3X,7HDENSITY,2X,9HCOND(BTU//15X,7H(DEG R),11H (LB
     2/CU FT),9H FT SC F),11X,7H(DEG R),11H (LB/CU FT),9H FT SC F))
  550 FORMAT (5X2I4,F9.2,F10.3,2XF8.2,1X2I4,F9.2,F10.3,F10.2)
 5500 FORMAT(5X,2I4,F9.2,F10.3,2X,F8.6,1X,2I4,F9.2,F10.3,F10.6)
  551 FORMAT(1H110X65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND A
     1BLATION PROGRAM/73X4HPAGEI3/1H 67X2A6)
  552 FORMAT(9X,67HOPTIONAL OUTPUT OF THERMOCOUPLE TEMPERATURES AND/OR I
     1SOTHERM DEPTHS/24X,37HDEPTHS MEASURED FROM ORIGINAL SURF  E/24X,
     231HTEMPERATURES IN DEGREES RANKINE//6X,77HEACH OUTPUT BLOCK SHOWS
     3THE TIME IN SECONDS, THE CURRENT SURFACE TEMPERATURE,/6X,20HTHE TE
     4MPERATURES OF ,I2,44H THERMOCOUPLES, AND THE DEPTHS IN INCHES OF ,
     5I2,10H ISOTHERMS//6X,74HTHE FIRST BLOCK SHOWS A SAMPLE TIME AND SU
     6RFACE TEMPERATURE. THE SPECIFIED/6X,73HDEPTHS OF THE THERMOCOUPLES
     7 (IF ANY) AND THE ISOTHERM TEMPERATURES.   THE/6X,76HARRANGEMENT O
     8F THIS BLOCK CORR SPONDS TO THE ARRANGEMENT OF THE OUTPUT DATA.//
     9(10(2X,F10.4)))
  553 FORMAT (//6X,11HOUTPUT DATA//)
  554 FORMAT (10(2X,F10.4))
  581 FORMAT(8F10.4/(10X7F10.4))
  582 FORMAT(12E10.3)
C
C
 7600 GO TO (7601,6061,761,761,761),JCMA
 7601 CONTINUE
      DNCP(3)=99999.
      SIG=.481E-12
C     CHAR AND PYROLYSIS ZONE CRITERIAL DENSITIES
      DNCP(1)=RHO(2)+CHCRI*(RHO(1)-RHO(2))
      DNCP(2)=RHO(2)+PYCRI*(RHO(1)-RHO(2))
C
C     INITIAL VALUES FOR TIME LOOP
C
 1300 ITER=-1
      DTHC=DTHB
      CMH=1.0
      THZRO=TPR(2)
      TNXT=TPR(2)
      TPR2=TPR2+THZRO
      TPR3=TPR3+THZRO
      THFIN=TPR(1)
      IZB=0
      ITS=0
      SA=0.0
```

```
      JSMT=0.0
      GSMS=0.
      CMO=0.0
      CMT=0.
      DSDTH=0.0
      DSDT=0.
      DSI=0.
      DIDT=0.
      CPE(1)=0.
      CPE(2)=0.
      COLD=0.
      POLD=0.
      PCDT=0.
      DPDT=0.
      QCOND=0.
      QCONV=0.
      QCHEM=0.
      RAD=0.
      GPH=0.
      QCONVT=0.
      QRPT=0.
      RADT=0.
      QCHEMT=0.
      QCONDT=0.
      PGPUT=0.
      DECOMT=0.
      DFDTT=0.
      QLOSST=0.
      TT=0.
      TR=0.
      SOEGR=0.
      GSEGR=0.
      PGPU=0.
      DECOM=0.
      EGO=0.
      HS=0.
      BR=0.
      KK=0
      TH=THZRO
      THDS=THZRO-DTHIN
      THPRT=TH
      REWIND 3
      CALL LCOUNT (-2,LCT,NPG,RECORD(35))
      WRITE (KOUT,542)
      IS=0
      DTH=DTHIN
      RSU=ABS(RSV)
      DELCR=AMIN1(DEL(1),DELM)/5.0
      TSAVE=TA(1)+1.0
      FA=(1.-PSIA)*BA*(RHOOA**(1.-PSIA))
      FB=(1.-PSIB)*BB*(RHOOB**(1.-PSIB))
      FC=(1.-PSIC)*BC*(RHOOC**(1.-PSIC))
C
C     BEGINNING OF TIME LOOP
C
  410 ITER=ITER+1
      JCMA=1
C
C     CALCULATION OF NODAL PROPERTIES
C
```

```
      DO 108 N=2,NL
  108 RA(N-1)=RA(N-1)+DSI
      RA(NL)=RA(NL)+DSI/2.
      CALL OSLF(NL,RA,RR,NUMN,RAV,AREA,EMA)
      ASU=RR(1)
      J=1-JFM-JF
  100 DO 105 N=1,NL
      J=J+JF
      RR(N)=RR(N)/ASU
      CALL LOOK (3,TA(N),TT2,TCP,TKP,THZ,0,Y2,Y2(4),3)
      CN(N)=Y2(2)
      CPV(N)=Y2(1)
      HP(N)=Y2(3)+DH1
      CALL LOOK (4,TA(N),TT2(1,2),TCP(1,2),TKP(1,2),THZ(1,2),0,Y2,D2,3)
      CNC(N)=Y2(2)
      CPC(N)=Y2(1)
      HC(N)=Y2(3)+DH2
      IF (MATL(N)-1) 103,101,102
  101 X(N)=1.
      CP(N)=CPV(N)
      H(N)=HP(N)
      RO(N)=RHO(1)
      ROT(N)=RHO(1)
      GO TO 105
  102 X(N)=0.
      CN(N)=Y2(2)
      H(N)=HC(N)
      CP(N)=CPC(N)
      RO(N)=RHO(2)
      ROT(N)=RHO(2)
      GO TO 105
  103 X(N) = PETE-PET/RO(N)
      H(N)=X(N)*HP(N)+(1.-X(N))*HC(N)
      CP(N)=X(N)*CPV(N)+(1.-X(N))*CPC(N)
      IF(N-1) 109,109,104
  109 ROT(1)=GAMA*(ROA(1)+ROB(1))+OMG*ROC(1)
      GO TO 105
  104 ROT(N)=(ROA(J)+ROB(J))*GAMA+OMG*(ROC(J))
  105 CONTINUE
      IF (NUMN-NBM) 112,106,106
  106 DO 107 N=NBM,NUMN
      RR(N)=AREA(N)/ASU
      KT=MATL(N)
      CALL LOOK(KT+2,TA(N),TT2(1,KT),TCP(1,KT),TKP(1,KT),0,0,Y2,D2,2)
      CP(N)=Y2(1)
      CN(N)=Y2(2)
      RAT(N)=DEL(N)/(CN(N)*RR(N))
  107 RO(N)=RHO(KT)
  112 HRES=SIG*EPSW*(TA(NUMN)+TRES)*(TA(NUMN)**2+TRES**2)+HCONV
      RAT(NUMN+1)=1./(HRES*RR(NUMN)+.00000001
      QLOSS=(TA(NL)-TA(NBM))/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
      QLOSST=QLOSST+QLOSS*DTH/AREA(1)*ASU
      CMT=CMT+RHO(2)*DSDT*ASU/AREA(1)*DTH
      DEL(NUMN+1)=CN(NUMN)/HRES
      RR(NUMN+1)=RR(NUMN)
      DTHS=DTH
      DTS=TSAVE-TA(1)
      IF(ITER) 151,113,151
  113 PFD1=0.
      ITER=1
```

```
      CH=TCH(2)
      JCMA=2
      GO TO 3000
C
C     OUTPUT
C
  151 JCMA=2
      IF(TH-TNXT+.00001) 700,3000,3000
  700 JCMA=1
      IF(TH-THPRT+.00001) 3410,3000,3000
 3410 IDUMP=1
      IF(KCM(4)) 4410,4410,3411
 3000 IDUMP=0
 3411 DIDT=12.*DSOTR
      NOR=NHM-NL-1
      NLI=(NUM+-NDR+1)/2
      CALL LCOUNT(33+NLI,LCT,NPG,RECORD(35))
  322 WRITE (KOUT,543)TH
      WRITE (KOUT,544)
      WRITE (KOUT,545) ITER,ITS,II    ,RSU,HW,HE,CH,BR
      WRITE (KOUT,546)
      WRITE (KOUT,547)
      AFRM=(GSMS+CMD)/CH
      BPRMG=GSMS/CH
      WRITE (KOUT,548) APRM,BPRMG,CMD,GSMS,CMT,GSMT
      WRITE (KOUT,5480) CHCRI,PYCRI
      WRITE (KOUT,5481) SA,DIDT,CPE(1),DCDT,CPE(2),DPDT
      WRITE (KOUT,5482)
 3224 WRITE (KOUT,5483) QCONV,QRP,RAD,QCHEM,QCOND,QCONVT,QRPT,RADT,QCHEM
     1T,QCONDT
      WRITE (KOUT,5484)
      WRITE (KOUT,5485)PGPU,DECOM, TB,DEDT,QLOSS,PGPUT,DECOMT, TT,DEDTT,
     1QLOSST
      IF (NCON) 3020,3020,3021
 3021 WRITE(KOUT,5490)
      GO TO 3022
 3020 WRITE(KOUT,549)
 3022 CONTINUE
      IF(IDUMP) 3023,3023,190
 3023 IF(NOI) 190,190,183
  183 CALL SLOPQ (NL,RA(1),TA(1),EMO(1),EMO(1))
      IF(NO) 182,182,184
  184 CALL OGLE (NO,SO,TO(1),NL,RA(1),TA(1),EMO(1))
  182 IF (NI) 189,189,185
  185 DO 186 I=1,NL
  186 EMO(I)=1./EMO(I)
      CALL OGLE (NI,SO(NO+1),TO(NO+1),NL,TA,RA,EMO)
  189 IF (NM) 188,188,187
  187 WRITE (7,581) TH,TS,(TO(I), I=1,NOI)
  188 WRITE (3) TH,TS, (TO(I), I=1,NOI)
      KK=KK+1
  190 CONTINUE
      IF (NCON) 3012,3012,3006
 3006 DO 3009 I=1,NL
      IF (NT) 3007,3007,3008
 3008 CALL LOOK(11,X(I),TX,F1,F2,0,0,Y1,D1,2)
      CNO(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
      GO TO 3009
 3007 CNO(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
 3009 CONTINUE
```

```
 3012 CONTINUE
      DO 3011 J=1,NLI
      K=NLI
      L=J
      IF (L-NL) 3002,3002,3001
 3001 L=L+NDR
      GO TO 3003
 3002 IF (L+NLI-NL) 3003,3003,3005
 3005 K=NLI+NDR
 3003 N=MINO(NUMN,K+L)
      IF (NCON) 3004,3004,3010
 3004 WRITE (KOUT,550) (I,MATL(I),TA(I),RO(I),H(I), I=L,N,K)
      GO TO 3011
 3010 WRITE(KOUT,5500)(I,MATL(I),TA(I),RO(I),CNO(I),I=L,N,K)
 3011 CONTINUE
      IF(IDUMP) 3225,3225,4410
 3225 IF(TH-THFIN+0.00001)1151,2    ,2
    2 JCMA=JCMA-1
      IF (NOI) 1,1,3
    3 REWIND 3
      CALL LCOUNT (-1,LCT,NFG,RECORD(35))
      WRITE (KOUT,552) NO,NI,TH,TS,(S0(I), I=1,NOI)
      WRITE (KOUT,553)
      DO 4 K=1,KK
      READ (3) TH,TS, (TO(I), I=1,NOI)
    4 WRITE (KOUT,554) TH,TS, (TO(I), I=1,NOI)
      GO TO 1
 1151 IF(JCMA-2) 606,799,606
 6061 TNXT=AMAX1(TPR(1),TPR(2))
  606 IF(TH-TPR2+0.00001)  154,158,158
  158 DTPRT=DTPR2
      DTPR2=DTPR3
      TPR2=TPR3
      TPR3=THFIN
  154 THPRT=AMIN1(THPRT+DTPRT,TPR2,TNXT)
 4410 DTH=AMIN1(DTHB,DELCR/(DSDTB+.0000001),TH-THDS, 50.0/(ABS(TSAVE-TA(
     11))+.1)*DTH)
      TSAVE=TA(1)
      DTH=(THPRT-TH)/(AINT((THPRT-TH)/DTH+1.0))
  144 TH=TH+DTH
  610 IF(DTH-.000001) 142,142,605
  142 WRITE (KOUT,582) TH,DTH,DTHS,DTHB,THDS,DTS,DELCR,DSDTB
      TH=THFIN
      JCMA=0
      GO TO 3000
C
C     INTERNAL DECOMPOSITION  --  DENSITY CALCULATION
  605 N=-JFH
C
C     SPECIFY SURFACE CHANGES DURING THIS TIME INTERVAL
      DSDT=DSDTB
      DS=DSDT*DTH
      DSI=12.0*DS
      SA=SA+DSI
      RSU=ABS(RSV+SA)
      DTHH=DTHC
      DEL(NL)=DEL(NL)-DS
      FK=0.0
      FJF=FJFH
      J1=JFHP
```

```
      RENOLD=RHO(2)                                         B31A 360
      COLD=CPE(1)                                           B31A 361
      POLD=CPE(2)                                           B31A 362
      CPE(1)=SA                                             B31A 363
      CPE(2)=SA                                             B31A 364
      IF=1                                                  B31A 365
      ROOZ=0.0                                              B31A 366
      TA(NL+1)=TA(NR )                                      B31A 369
      DEL(NL+1)=DEL(NR )                                    B31A 370
      RR(NL+1)=RR(NRR)                                      B31A 371
      DO 252 I=1,NL                                         B31A 372
      ISV=MIN0(NL,I+1)
      DROG(I)=0.0                                           B31A 373
      RON(I)=ROOZ                                           B31A 374
      DSS=FJF/DEL(I)*DSOT                                   B31A 375
      J2=J1                                                 B31A 376
      DO 255 J=J2,JF                                        B31A 377
      N=N+J1-1                                              B31A 378
      IF (J-JFHF) 253,259,253                               B31A 379
  259 IF(MATL(I)+MATL(ISV)-4) 263,260,263
  263 IF(AMAX1(TA(I),TA(I+1))-TRACH)261,261,262             B31A 381
  261 IF(MATL(I)+MATL(I)+MATL(ISV)-3) 262,260,262
  260 J1=JFHP                                               B31A 383
      ROOZ=FJFH*RO(I+1)                                     B31A 384
      RON(I)=RON(I)+FJFH*RO(I)                              B31A 385
      N=N+JFH                                               B31A 386
      GO TO 264                                             B31A 387
  262 ROOZ=0.0                                              B31A 388
      J1=1                                                  B31A 389
      DTA=(TA(I+1)-TA(I))/(FJFS+FJF/DEL(I)*DEL(I+1)/RR(I)*RR(I+1))  B31A 390
      TAS=TA(I)                                             B31A 391
  253 N=N+1                                                 B31A 392
      IF(ABS(DSS)-.000001) 1016,1016,1017                   B31A 393
 1016 DROAC=0.                                              B31A 394
      DROBC=0.                                              B31A 395
      DROCC=0.                                              B31A 396
      GO TO 1021                                            B31A 397
 1017 IF(I-NL) 1015,1018,1015                               B31A 398
 1018 FK=FK-1.0                                             B31A 399
      IF(FK) 1019,1016,1020                                 B31A 400
 1019 FK=FJF-1.0                                            B31A 401
 1020 DSS=DSOT/DEL(I)*FK                                    B31A 402
 1015 IF ( -1) 1115,1215,1115                               B31A 403
 1115 DROAC=(ROA(N+1)-ROA(N))*DSS                           B31A 404
      DROBC=(ROB(N+1)-ROB(N))*DSS                           B31A 405
      DROCC=(ROC(N+1)-ROC(N))*DSS                           B31A 406
      GO TO 1021                                            B31A 407
 1215 CONTINUE                                              B31A 408
 1315 DROAC=(ROA(N+1)-RHORA)*DSS                            B31A 409
      DROBC=(ROB(N+1)-RHORB)*DSS                            B31A 410
      DROCC=(ROC(N+1)-RHORC)*DSS                            B31A 411
      ROT(1)=RHO(2)                                         B31A 412
 1021 TAS=TAS+DTA                                           B31A 413
      IF(TAS-TRACA) 227,227,229                             B31A 414
  229 IF(TAS  -TRACA) 201,201,202                           B31A 415
  201 DROAT=0.0                                             B31A 416
      GO TO 2113                                            B31A 417
  202 IF(RHORA-ROA(N)) 211,201,201                          B31A 418
  211 RO=ROA(N)-RHORA                                       B31A 419
      RC=1.-PSIA                                            B31A 420
```

```
      IF(POW)2111,2112,2111
 2111 DROAT=(-RD+((RD**POW)-                      FA*EXP(-EA/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2113
 2112 DROAT=RD*(EXP(-RA*DTH*EXP(-EA/TAS))-1.)/DTH
 2113 ROA(N)=ROA(N)+(DROAT+DROAC)*DTH
  221 IF(TAS  -TRACA)203,203,204
  203 DROBT=0.0
      GO TO 2133
  204 IF(RHORB-ROB(N))213,203,203
  213 RD=ROB(N)-RHORB
      POW=1.-PSIB
      IF(POW)2131,2132,2131
 2131 DROBT=(-RD+((RD**POW)-                      FB*EXP(-EB/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2133
 2132 DROBT=RD*(EXP(-RB*DTH*EXP(-EB/TAS))-1.)/DTH
 2133 ROB(N)=ROB(N)+(DROBT+DROBC)*DTH
  223 IF(TAS  -TRACC) 205,205,206
  205 DROCT=0.0
      GO TO 2153
  206 IF(RHORC-ROC(N))215,205,205
  215 RD=ROC(N)-RHORC
      POW=1.-PSIC
      IF (POW) 2151,2152,2151
 2151 DROCT=(-RD+((RD**POW)-                      FC*EXP(-EC/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2153
 2152 DROCT=RD*(EXP(-RC*DTH*EXP(-EC/TAS))-1.)/DTH
 2153 ROC(N)=ROC(N)+(DROCT+DROCC)*DTH
  225 DMDG(I)=DMDG(I)-DEL(I)*((DROAT+DROBT)*GAMA+OMG*DROCT)
  227 DNS=(ROA(N)+ROB(N))*GAMA+OMG*ROC(N)
      RON(I)=RON(I)+DNS
      IF(N-1) 2251,2253,2251
 2251 IF(DNS-DNCP(IE)) 2253,2252,2252
 2252 CPE(IE)=DEL(I)*((FLOAT(N)-0.5)/FJF+1.-FLOAT(I))*12.+RA(I)
      CPE(IE)=CPE(IE)-DEL(I)/(DNS-DENOLD)*(DNS-DNCP(IE))/FJF*12.
      CPE(IE)=AMAX1(CPE(IE),SA)
      IE=IE+1
 2253 DENOLD=DNS
  255 TAS=TAS+DTA
  264 DMDG(I)=DMDG(I)/FJF*RR(I)
      RON(I)=RON(I)/FJF
      IF(I-1) 257,257,254
  257 FJF=FJFS
      DTA=DTA/DEL(1)*DEL(2)/2.*RR(2)
      GO TO 252
  254 DTA=DTA/DEL(I)*DEL(I+1)/RR(I)*RR(I+1)
  252 CONTINUE
C     NOW SPECIFY NECESSARY NEW POST-DECOMPOSITION PROPERTIES
      J=JFHP
      DO 85 I=1,NL
      IF(ABS(RON(I)-RHO(1))-.01) 81,81,82
   81 MATL(I)=1
      X(I)=1.0
      GO TO 85
   82 IF (ABS(RON(I)-RHO(2))-.01) 83,83,84
   83 MATL(I)=2
      X(I)=0.
      C(I)=CNC(I)
```

```
      GO TO 85
   84 MATL(I)=1
      X(I)=PETE-PET/RON(I)
      IF (KT) 8500,8500,8501
 8501 CALL LOOK(11,X(I),TX,F1,F2,0,0,Y1,D1,2)
      CN(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
      GO TO 85
 8500 CN(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
   85 RAT(I)=DEL(I)/(CN(I)*RR(I))
      GSM=0.0
      DO 122 I=1,NL
  122 GSM=GSM+DMDG(I)
      GSMS=GSM
      GSMT=GSMT+GSMS*ASU/AREA(1)*DTH
      DSDT=(CPE(1)-COLD)/DTH
      DPDT=(CPE(2)-POLD)/DTH
C
C         CALCULATION OF IMPLICIT TEMPERATURE COEFFICIENTS
C         AND INTERNAL ENERGY RATE TERMS
C     MAIN BLOCK
      DVB=0.
      SMEGR=0.
      SPEGR=0.
      TR=0.
      RAT(1)=2.*RAT(1)
      CPNL=CP(NL)
      NLM=NL-1
      IMIN=0
      DO 30 I=IMIN,NLM
      IF (I) 15,15,14
   14 GSM=GSM-DMDG(I)
      DRODTD=-DMDG(I)/(RR(I)*DEL(I))
      FACT1=DTH/(DEL(I)*RR(I))
      FACT2=GSM/(DEL(I)*RR(I))
      A(I)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
      TERM2=RON(I)*CP(I)-DTH*(CPGAS*(DRODTD-FACT2)
     1         -DSDT*RO1*CP1/DEL(I))
      TERM1=FACT1*DVB
      B(I)=TERM2-A(I)+TERM1
      C(I)=-TERM1
      D(I)=TA(I)*TERM2+(HGAS*DRODTD-HBAR*(RON(I)
     1       -RO(I))/DTH-FACT2*HGAS-DSDT*RO1*H1/DEL(I))*DTH
   15 RO1=RO(I+1)
      X1=PETE-PET/RO1
      CP1=CPV(I+1)*X1+CPC(I+1)*(1.0-X1)
      H1=HF(I+1)*X1+HC(I+1)*(1.0-X1)
      CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
      T[illegible]=-RO1*HBAR+RO1*H1*[illegible]
      HBAR=PETE*HF(I+1)-PET/RH[illegible]1)*HC(I+1)
      [illegible]=RO1*[illegible]*RO1*HBAR
   [illegible] CALL LOOK [illegible],THG,0,0,0,HGAS,CPGAS,1)
      [illegible]
      [illegible]
      [illegible]
      IF ([illegible]) 24,24,[illegible]
   24 [illegible]GAS
      [illegible]=HGAS
      [illegible]
   [illegible] [illegible] DEL[illegible]*DTH
```

```
      C(I)=C(I)+TERM3
      D(I)=D(I)+TA(I+1)*TERM3+(FACT2*HGAS+DSDT*RO1*H1/DEL(I))*DTH
      TB=TB-TN*DSDT*RR(I)
   30 CONTINUE
      A(1)=DTH/DEL(1)
      TT=TT+TB*DTH/AREA(1)*ASU
C     NOW THE LAST ABLATING NODE REQUIRES DIFFERENT TREATMENT
      DRODTD=-DMDG(NL)/(RR(NL)*DEL(NL))
      FACT1=DTH/(DEL(NL)*RR(NL))
      A(NL)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
      C(NL)=-FACT1*DVB
      TERM2=RON(NL)*CP(NL)-(CPGAS*DRODTD+(DSDT/DEL(NL))*
     1          (RO (NL)*CPNL  -RO1*CP1))*DTH
      B(NL)=TERM2-C(NL)-A(NL)
      D(NL)=TA(NL)*TERM2+DTH*(HGAS*DRODTD-HRAR*(RON(NL)-
     1          RO(NL))/DTH+DSDT*(RO (NL)*H(NL)-RO1*H1)/DEL(NL))
C     NOW FOR BACK UPS IF ANY
      K = NL
      IF(NUMN-NBM) 60,40,40
   40 DO 50 I=NBM,NUMN
      K=K+1
      FACT1=DTH/(DEL(I)*RR(I))
      A(K) = -FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
      C(K)=-FACT1*DVB
      B(K)=RO(I)*CP(I)-C(K)-A(K)
   50 D(K)=TA(I)*RO(I)*CP(I)
C     NOW IF THE LAST NODE WAS INSULATED WE MUST REPAIR LAST B AND C
   60 IF(HRES) 80,70,80
   70 B(K)=B(K)+C(K)
      C(K)=0.
C     NOW BEFORE GAUSS REDUCTION REWRITE LAST LINE OF MATRIX
   80 D(K)=D(K)-C(K)*TRES
      L=K
      DO 90 I=2,K
      L=L-1
      D(L)=D(L)-C(L)/B(L+1)*D(L+1)
   90 B(L)=B(L)-C(L)/B(L+1)*A(L+1)
      B(1)=B(1)/A(1)
      D(1)=D(1)/[illegible])
      PGPU=EGO-GSEGR
      PGPUT=PGPUT+PGPU*DTH/AREA(1)*ASU
      DFCOM=GSEGR-SOEGR
      DFCOMT=DFCOMT+DFCOM*DTH/AREA(1)*ASU
C
C     SURFACE BOUNDARY CONDITION PACKAGE
  761 CALL SBCPKG
C
      IF(JCMA-2) 780,780,799
  780 IF(JCMA) 148,3000,148
  148 CONTINUE
C
C     SHRINK (AND DROP) OF LAST ABLATING NODE
C
C     DEL(NL)=DEL(NL)-DS (SEE INT DECOMP)
      IF(DEL(NL)-DELM)149,149,150
  149 DRLP=DEL(NL)*RO(NL)*RR(NL)
      DRLCP=DRLP*CP(NL)
      NL=NL-1
```

```
      RC(NL)=RC(NL+1)
      DRL=DEL(NL)*RO(NL)*RR(NL)
      DRLC=DRL*CP(NL)
      HAPHB=DRL*H(NL)+DRLP*H(NL+1)
      TOP1=DRL+DRLP
      TOP2=DRLC+DRLCP
      TOP3=DRLC*TA(NL) +DRLCP*TA(NL+1)
      VOL=DEL(NL)*RR(NL)+DEL(NL+1)*RR(NL+1)
      DEL(NL)=DEL(NL)+DEL(NL+1)
      RO(NL)=TOP1/VOL
      CP(NL)=TOP2/TOP1
      TA(NL)=TOP3/TOP2
      H(NL)=HAPHB/TOP1
      DELR=DEL(NL+1)*RR(NL+1)/VOL
      CZ=1.0-DELR
      DZ=0.0
      GZ=CZ
      NZ=JF*NL-JFH
      N=NZ-JF+1
      K=N
      FZ=DELR
      EZ=GZ
      GO TO 179
  172 DZ=DZ+1.0
  173 FZ=DZ-CZ
      IF(K-NZ) 175,174,175
  174 GZ=DELR
  175 K=K+1
      CZ=CZ+GZ
  176 EZ=CZ-DZ
      IF(EZ)178,177,177
  177 ROA(N)=ROA(N)+FZ*ROA(K)
      ROB(N)=ROB(N)+FZ*ROB(K)
      ROC(N)=ROC(N)+FZ*ROC(K)
      IF(N-NZ) 171,150,171
  171 N=N+1
  179 ROA(N)=ROA(K)*EZ
      ROB(N)=ROB(K)*EZ
      ROC(N)=ROC(K)*EZ
      GO TO 172
  178 ROA(N)=ROA(N)+ROA(K)*GZ
      ROB(N)=ROB(N)+ROB(K)*GZ
      ROC(N)=ROC(N)+ROC(K)*GZ
      GO TO 173
C
  150 GO TO 410
    1 RETURN
  799 CONTINUE
      RETURN
      END
```

(3) Flow Chart

```
C031A
      SUBROUTINE CMA
C       TWO MOVING BOUNDARY INTERNAL CONDUCTION PACKAGE
C       AEROTHERM CORPORATION    RM KENDALL  C MOYER
```

```
 7600 GO TO (7601,6061,761,761,761),JCMA
```

```
 7601 CONTINUE
      DNCP(3)=99999.
      SIG=.481E-12
C     CHAR AND PYROLYSIS ZONE CRITERIAL DENSITIES
      DNCP(1)=RHO(2)+CHCRI*(RHO(1)-RHO(2))
      DNCP(2)=RHO(2)+PYCRI*(RHO(1)-RHO(2))
C
C     INITIAL VALUES FOR TIME LOOP
C
 1330 ITER=-1
      DTHC=DTHB
      CMH=1.0
      THZRO=TPR(2)
      TNXT=TPR(2)
      TPR2=TPR2+THZRO
      TPR8=TPR6+THZRO
      THFIN=TPR(1)
      IAB=0
      ITS=0
      SA=0.0
      GSMT=0.0
      GSMS=0.
      CMD=0.0
      CMT=0.
      DSDTB=0.0
      DSDT=0.
      DSI=0.
      DIDT=0.
      CPE(1)=0.
      CPE(2)=0.
      COLD=0.
      POLD=0.
      DCDT=0.
      DPDT=0.
      QCOND=0.
      QCONV=0.
      QCHEM=0.
      RAD=0.
      QRP=0.
      QCONVT=0.
      QRPT=0.
      RADT=0.
      QCHEMT=0.
      QCONDT=0.
      PGPUT=0.
      DECOMT=0.
      DEDTT=0
      QLOSST=0.
      TT=0.
      TB=0.
      SOEGR=0.
      GSEGR=0.
      PGPU=0.
      DECOM=0.
      EGO=0.
      HW=0.
      BR=0.
      KK=0
      TH=THZRO
      THOS=THZRO-DTHIN
      THPRT=TH
```

```
      REWIND 3
      CALL LCOUNT (-2,LCT,NPG,RECORD(35))
      WRITE (KOUT,542)
      IS=0
      DTH=DTHIN
      RSU=ABS(RSV)
      DELCR=AMIN1(DEL(1),DELM)/5.0
      TSAVE=TA(1)+1.0
      FA=(1.-PSIA)*BA*(RHOOA**(1.-PSIA))
      FB=(1.-PSIB)*BB*(RHOOB**(1.-PSIB))
      FC=(1.-PSIC)*BC*(RHOOC**(1.-PSIC))
C
C     BEGINNING OF TIME LOOP
C

  410 ITER=ITER+1
      JCMA=1
C
C     CALCULATION OF NODAL PROPERTIES
C

      DO 108 N=2,NL

  108 RA(N-1)=RA(N-1)+DSI

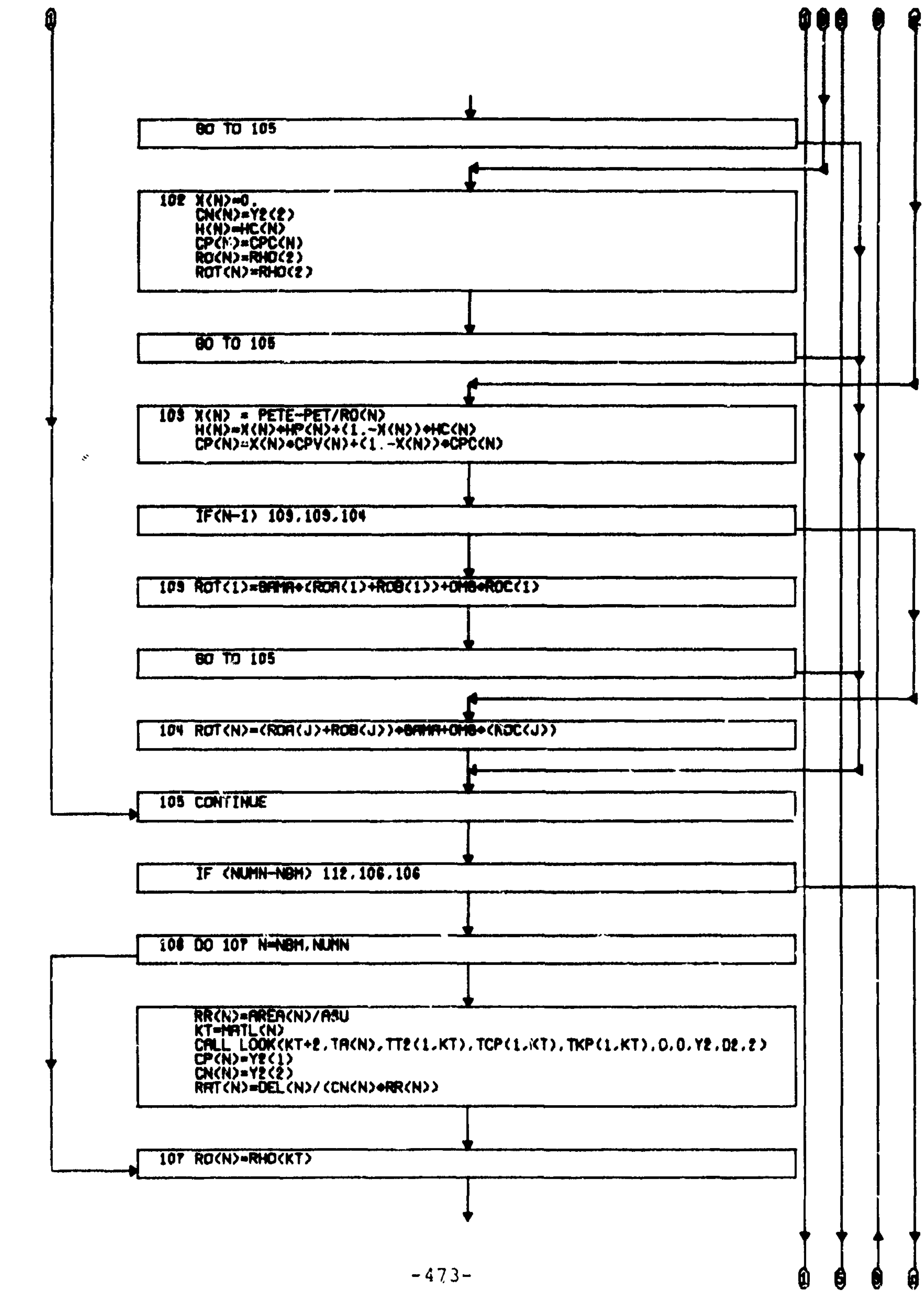
      RA(NL)=RA(NL)+DSI/2.
      CALL DBLE(NL,RA,RR,NUMN,RAV,AREA,EMA)
      ASU=RR(1)
      J=1-JFH-JF

  100 DO 105 N=1,NL

      J=J+JF
      RR(N)=RR(N)/ASU
      CALL LOOK (3,TA(N),TT2,TCP,TKP,THZ,0,Y2,Y2(4),3)
      CN(N)=Y2(2)
      CPV(N)=Y2(1)
      HP(N)=Y2(3)+DH1
      CALL LOOK (4,TA(N),TT2(1,2),TCP(1,2),TKP(1,2),THZ(1,2),0,Y2,D2,3)
      CNC(N)=Y2(2)
      CPC(N)=Y2(1)
      HC(N)=Y2(3)+DH2

      IF (MATL(N)-1) 103,101,102

  101 X(N)=1.
      CP(N)=CPV(N)
      H(N)=HP(N)
      RO(N)=RHO(1)
      ROT(N)=RHO(1)
```


GO TO 105
102 X(N)=0.
CN(N)=Y2(2)
H(N)=HC(N)
CP(N)=CPC(N)
RO(N)=RHO(2)
ROT(N)=RHO(2)
GO TO 105
103 X(N) = PETE-PET/RO(N)
H(N)=X(N)*HP(N)+(1.-X(N))*HC(N)
CP(N)=X(N)*CPV(N)+(1.-X(N))*CPC(N)
IF(N-1) 109,109,104
109 ROT(1)=GAMA*(ROA(1)+ROB(1))+OMG*ROC(1)
GO TO 105
104 ROT(N)=(ROA(J)+ROB(J))*GAMA+OMG*(ROC(J))
105 CONTINUE
IF (NUMN-NBM) 112,106,106
106 DO 107 N=NBM,NUMN
RR(N)=AREA(N)/ASU
KT=MATL(N)
CALL LOOK(KT+2,TA(N),TT2(1,KT),TCP(1,KT),TKP(1,KT),0,0,Y2,D2,2)
CP(N)=Y2(1)
CN(N)=Y2(2)
RAT(N)=DEL(N)/(CN(N)*RR(N))
107 RO(N)=RHO(KT)

```
112 HRES=SIG*EPSN*(TR(NUMN)+TRES)*(TR(NUMN)**2+TRES**2)+HCONV
    RAT(NUMN+1)=1./(HRES*RR(NUMN)+.00000001)
    QLOSS=(TR(NL)-TR(NBM))/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
    QLOSST=QLOSST+QLOSS*DTH/AREA(1)*RSU
    CMT=CMT+RHO(2)*DSDT*RSU/AREA(1)*DTH
    DEL(NUMN+1)=CN(NUMN)/HRES
    RR(NUMN+1)=RR(NUMN)
    DTHB=DTH
    DTS=TSAVE-TR(1)

    IF(ITER) 151,113,151

113 DEDT=0.
    ITER=1
    CH=TCH(2)
    JCMA=2

    GO TO 3000

C
C   OUTPUT
C

151 JCMA=2

    IF(TH-TNXT+.00001) 700,3000,3000

700 JCMA=1

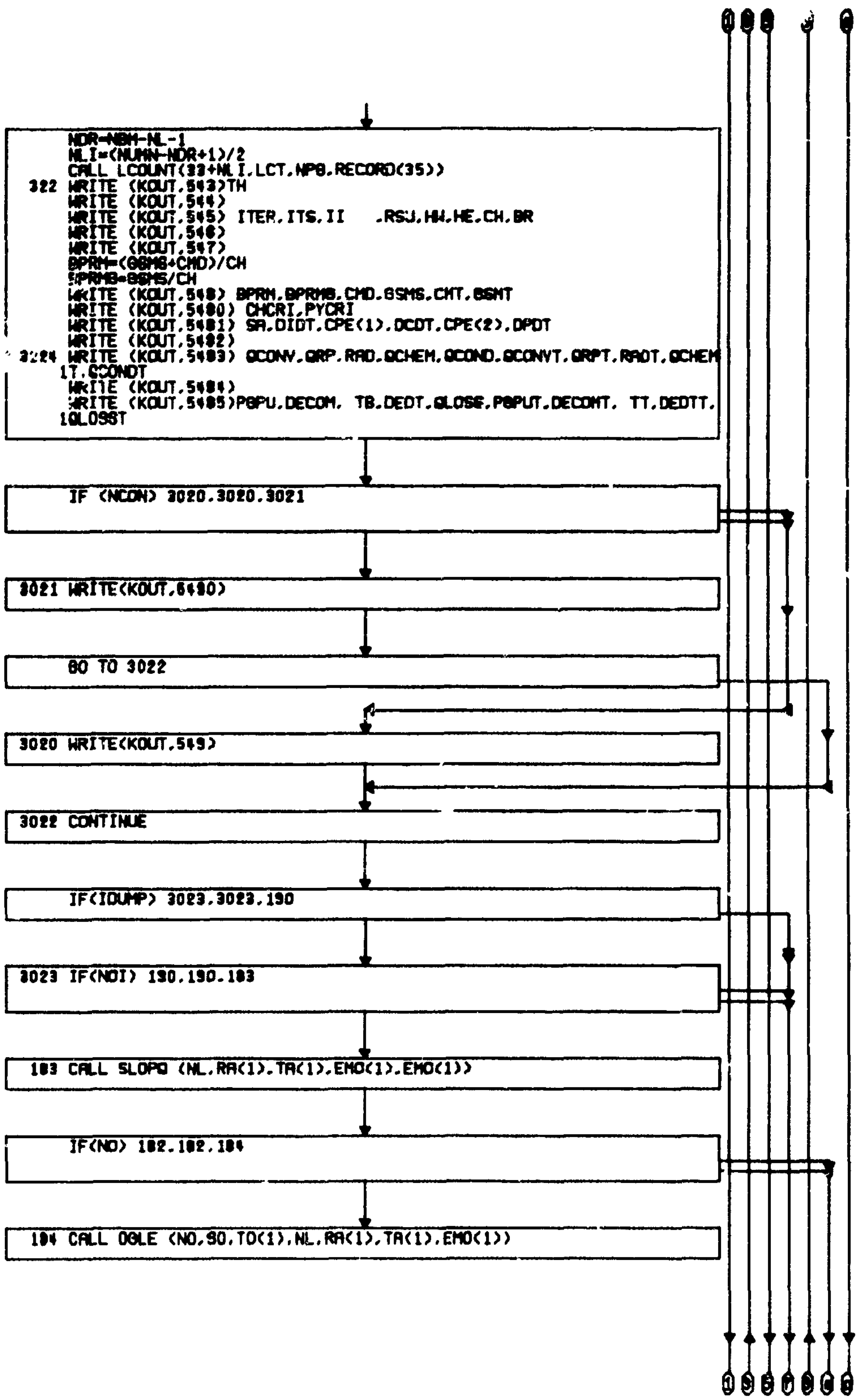
    IF(TH-THPRT+.00001) 3410,3000,3000

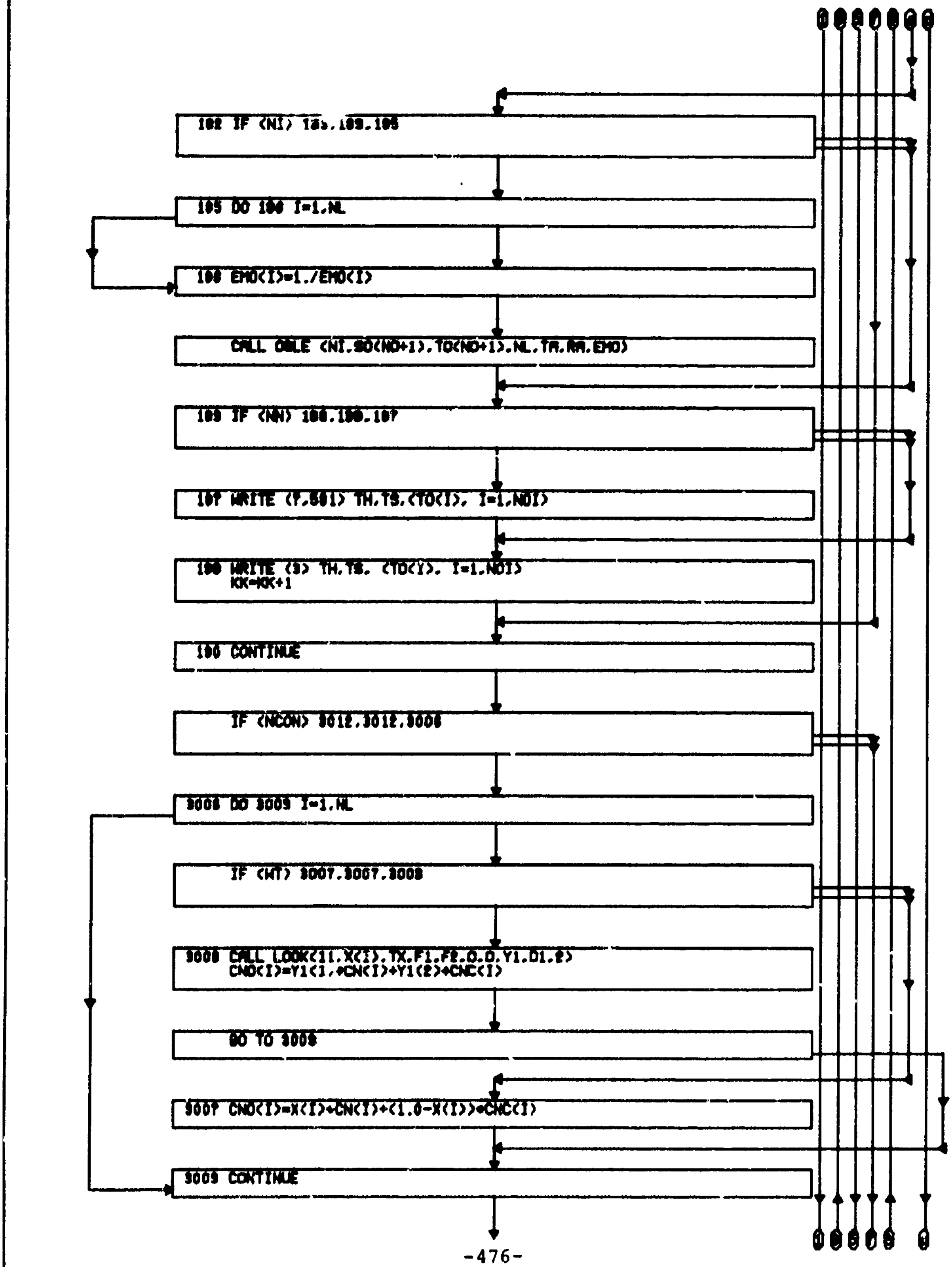
3410 IDUMP=1

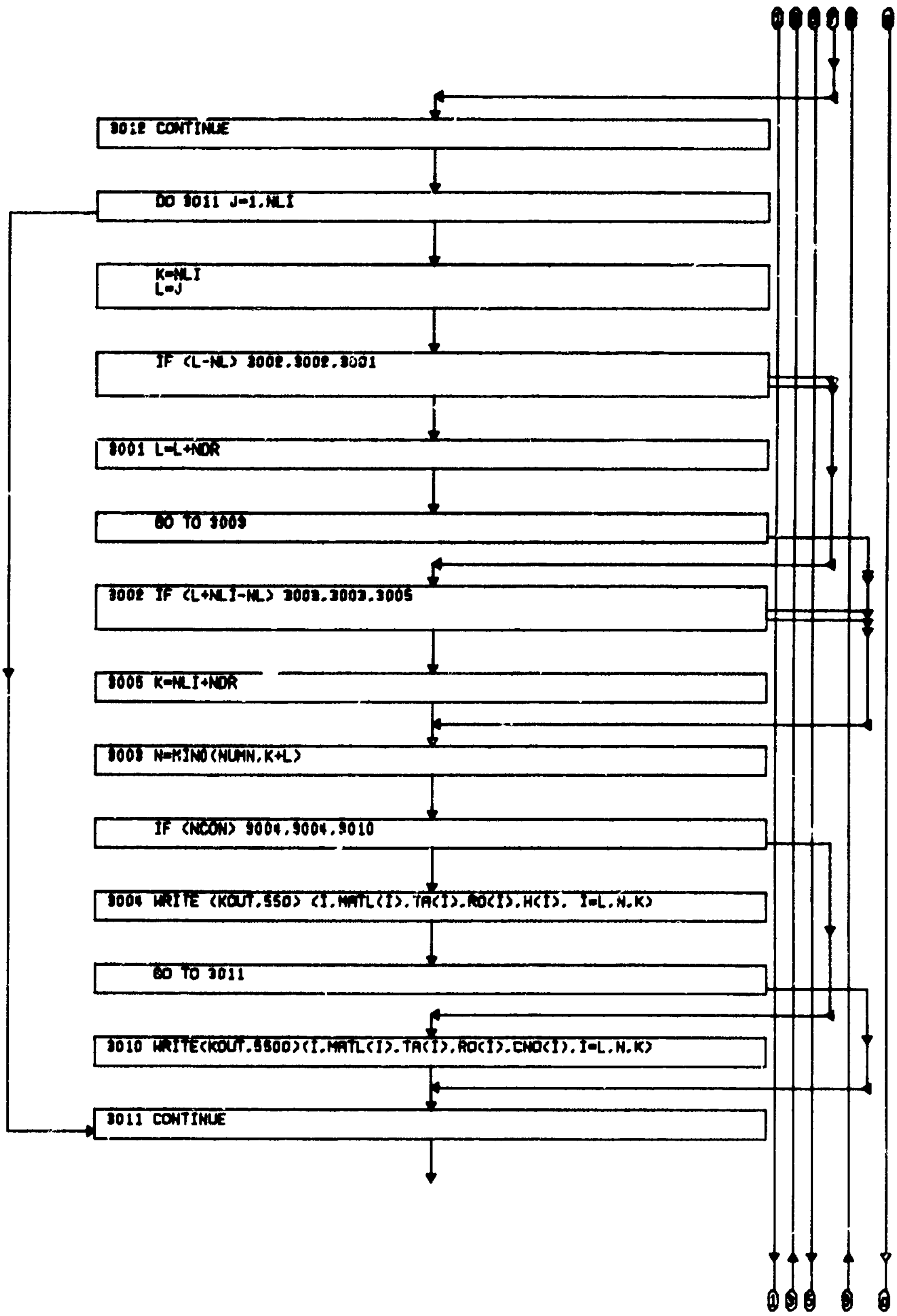
    IF(KCH(4)) 4410,4410,3411

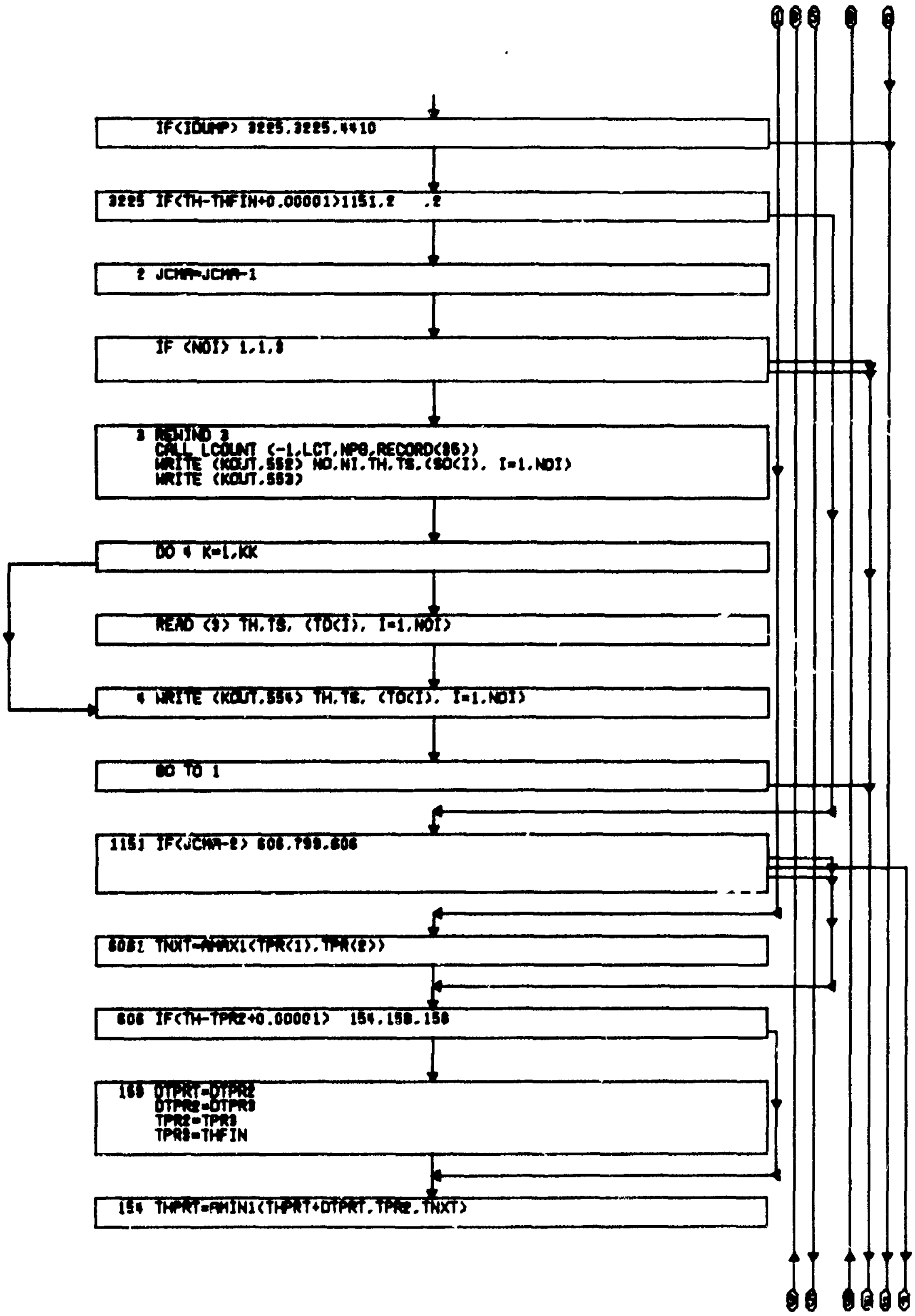
3000 IDUMP=0

3411 DIDT=12.*DSDTB
```


NDR=NBM-NL-1
NLI=(NUMN-NDR+1)/2
CALL LCOUNT(33+NLI.LCT.NPG.RECORD(35))
322 WRITE (KOUT,543)TH
WRITE (KOUT,544)
WRITE (KOUT,545) ITER.ITS.II .RSJ.HW.HE.CH.BR
WRITE (KOUT,546)
WRITE (KOUT,547)
BPRM=(GSMS+CMD)/CH
BPRMS=GSMS/CH
WRITE (KOUT,548) BPRM.BPRMS.CMD.GSMS.CMT.GSMT
WRITE (KOUT,5400) CHCRI.PYCRI
WRITE (KOUT,5401) SA.DIDT.CPE(1).DCDT.CPE(2).DPDT
WRITE (KOUT,5402)
3224 WRITE (KOUT,5403) QCONV.QRP.RAD.QCHEM.QCOND.QCONVT.QRPT.RADT.QCHEM
1T.QCONDT
WRITE (KOUT,5404)
WRITE (KOUT,5405)PGPU.DECOM. TB.DEDT.QLOSS.PGPUT.DECOMT. TT.DEDTT.
1QLOSST
IF (NCON) 3020.3020.3021
3021 WRITE(KOUT,6400)
GO TO 3022
3020 WRITE(KOUT,549)
3022 CONTINUE
IF(IDUMP) 3023.3023.190
3023 IF(NOI) 190.190.183
183 CALL SLOPQ (NL.RA(1).TA(1).EMO(1).EMO(1))
IF(NO) 182.182.184
184 CALL QGLE (NO,SO,TO(1).NL.RA(1),TA(1).EMO(1))


102 IF (NI) 105.109.105
105 DO 106 I=1.NL
106 EMO(I)=1./EMO(I)
CALL ODLE (NI.SO(NO+1).TO(NO+1).NL.TR.RR.EMO)
109 IF (NN) 108.108.107
107 WRITE (7.501) TH.TS.(TO(I). I=1.NOI)
108 WRITE (3) TH.TS. (TO(I). I=1.NOI)
KK=KK+1
100 CONTINUE
IF (NCON) 3012.3012.3006
3006 DO 3009 I=1.NL
IF (WT) 3007.3007.3008
3008 CALL LOOK(11.X(I).TX.F1.F2.0.0.Y1.D1.2)
CNO(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
GO TO 3009
3007 CNO(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
3009 CONTINUE


3012 CONTINUE
DO 3011 J=1,NLI
K=NLI
L=J
IF (L-NL) 3002,3002,3001
3001 L=L+NDR
GO TO 3003
3002 IF (L+NLI-NL) 3003,3003,3005
3005 K=NLI+NDR
3003 N=MINO(NUMN,K+L)
IF (NCON) 3004,3004,3010
3004 WRITE (KOUT,550) (I,MATL(I),TA(I),RO(I),H(I), I=L,N,K)
GO TO 3011
3010 WRITE(KOUT,5500)(I,MATL(I),TA(I),RO(I),CNO(I),I=L,N,K)
3011 CONTINUE


IF(IDUMP) 3225,3225,4410
3225 IF(TH-THFIN+0.00001)1151,2 ,2
2 JCMA=JCMA-1
IF (NOI) 1,1,3
3 REWIND 3
CALL LCOUNT (-1,LCT,NPG,RECORD(86))
WRITE (KOUT,552) NO,NI,TH,TS,(SO(I), I=1,NOI)
WRITE (KOUT,553)
DO 4 K=1,KK
READ (3) TH,TS, (TO(I), I=1,NOI)
4 WRITE (KOUT,554) TH,TS, (TO(I), I=1,NOI)
GO TO 1
1151 IF(JCMA-2) 606,799,606
6081 TNXT=AMAX1(TPR(1),TPR(2))
606 IF(TH-TPR2+0.00001) 154,158,158
158 DTPRT=DTPR2
DTPR2=DTPR3
TPR2=TPR3
TPR3=THFIN
154 THPRT=AMIN1(THPRT+DTPRT,TPR2,TNXT)

```
4410 DTH=AMIN1(DTHB,DELCR/(DSDTB+.0000001),TH-THDS, 50.0/(ABS(TSAVE-TA(
    1))+.1)*DTH)
     TSAVE=TA(1)
     DTH=(THPRT-TH)/(AINT((THPRT-TH)/DTH+1.0))
 144 TH=TH+DTH
```

```
 610 IF(DTH-.000001) 162,162,608
```

```
 162 WRITE (KOUT,582) TH,DTH,DTHS,DTHB,THDS,DTS,DELCR,DSDTB
     TH=THFIN
     JCMA=0
```

```
     GO TO 3000
```

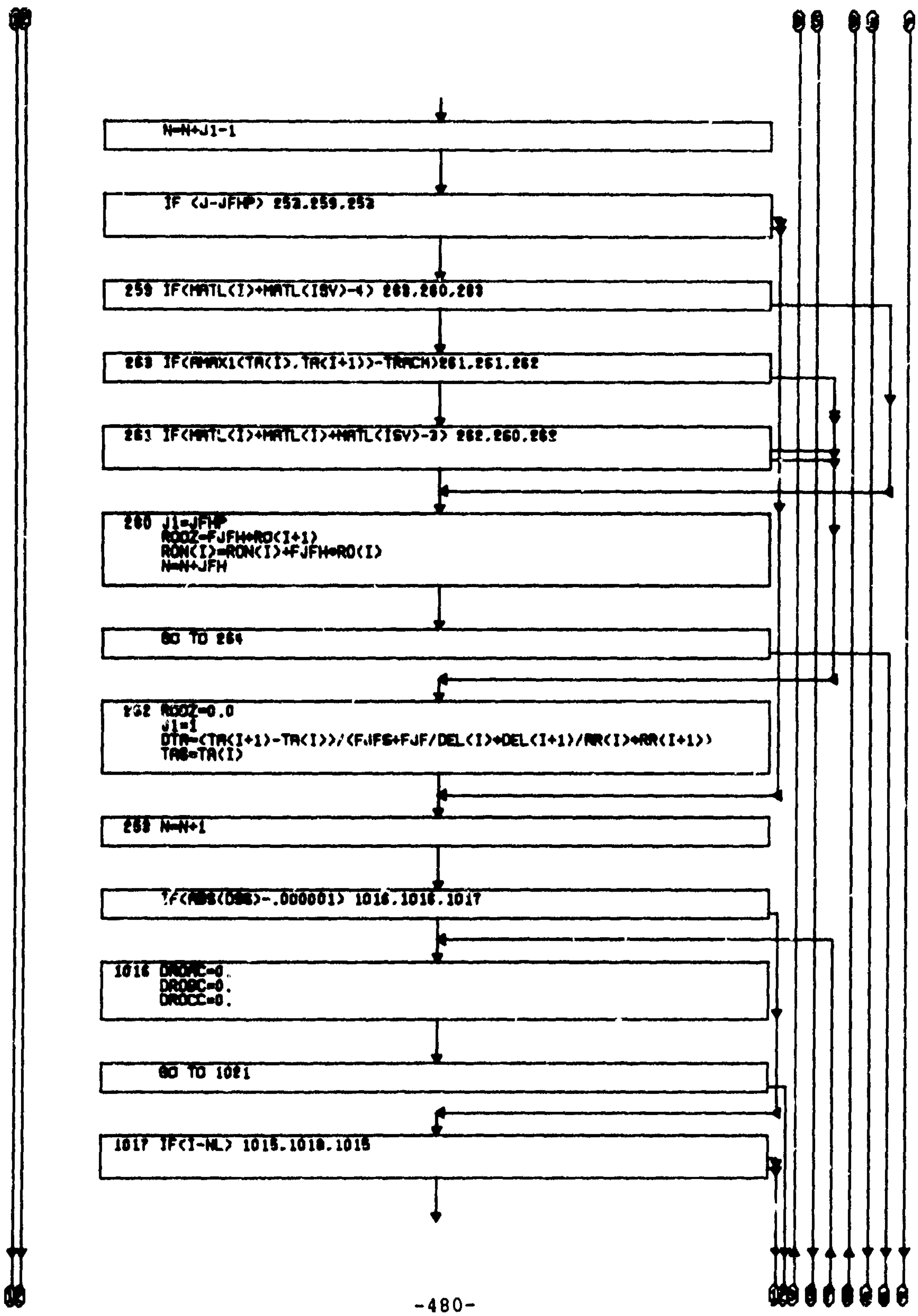
```
C
C     INTERNAL DECOMPOSITION  --  DENSITY CALCULATION
```

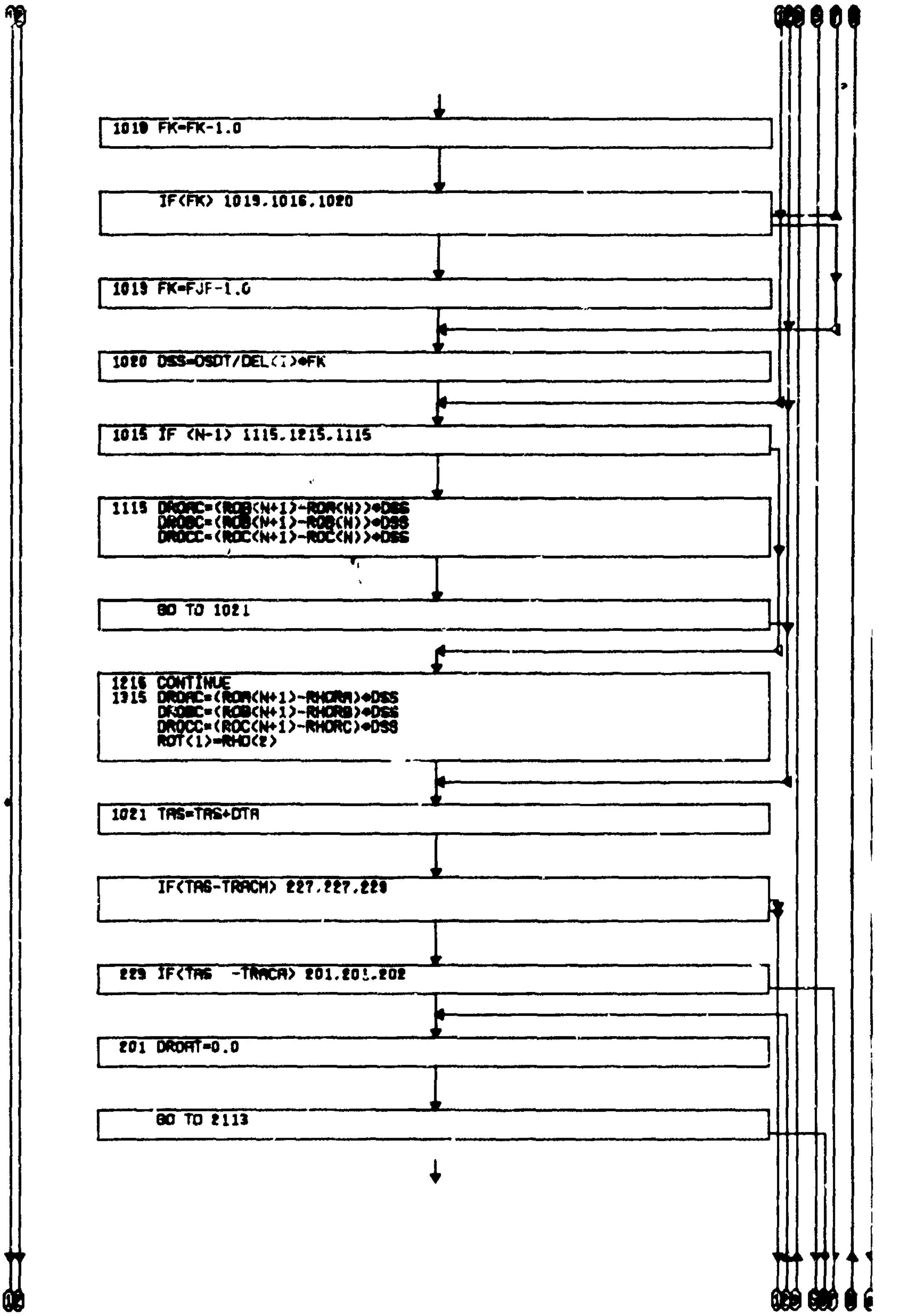
```
 608 N=-JFH
C
C     SPECIFY SURFACE CHANGES DURING THIS TIME INTERVAL
     DSDT=DSDTB
     DS=DSDT*DTH
     DSI=12.0*DS
     SA=SA+DSI
     RSU=ABS(RSV+SA)
     DTHB=DTHC
     DEL(NL)=DEL(NL)-DS
     FK=0.0
     FJF=FJFH
     J1=JFHP
     DENOLD=RHO(2)
     COLD=CPE(1)
     POLD=CPE(2)
     CPE(1)=SA
     CPE(2)=SA
     IE=1
     ROOZ=0.0
     TA(NL+1)=TA(NBM)
     DEL(NL+1)=DEL(NBM)
     RR(NL+1)=RR(NBM)
```

```
     DO 262 I=1,NL
```

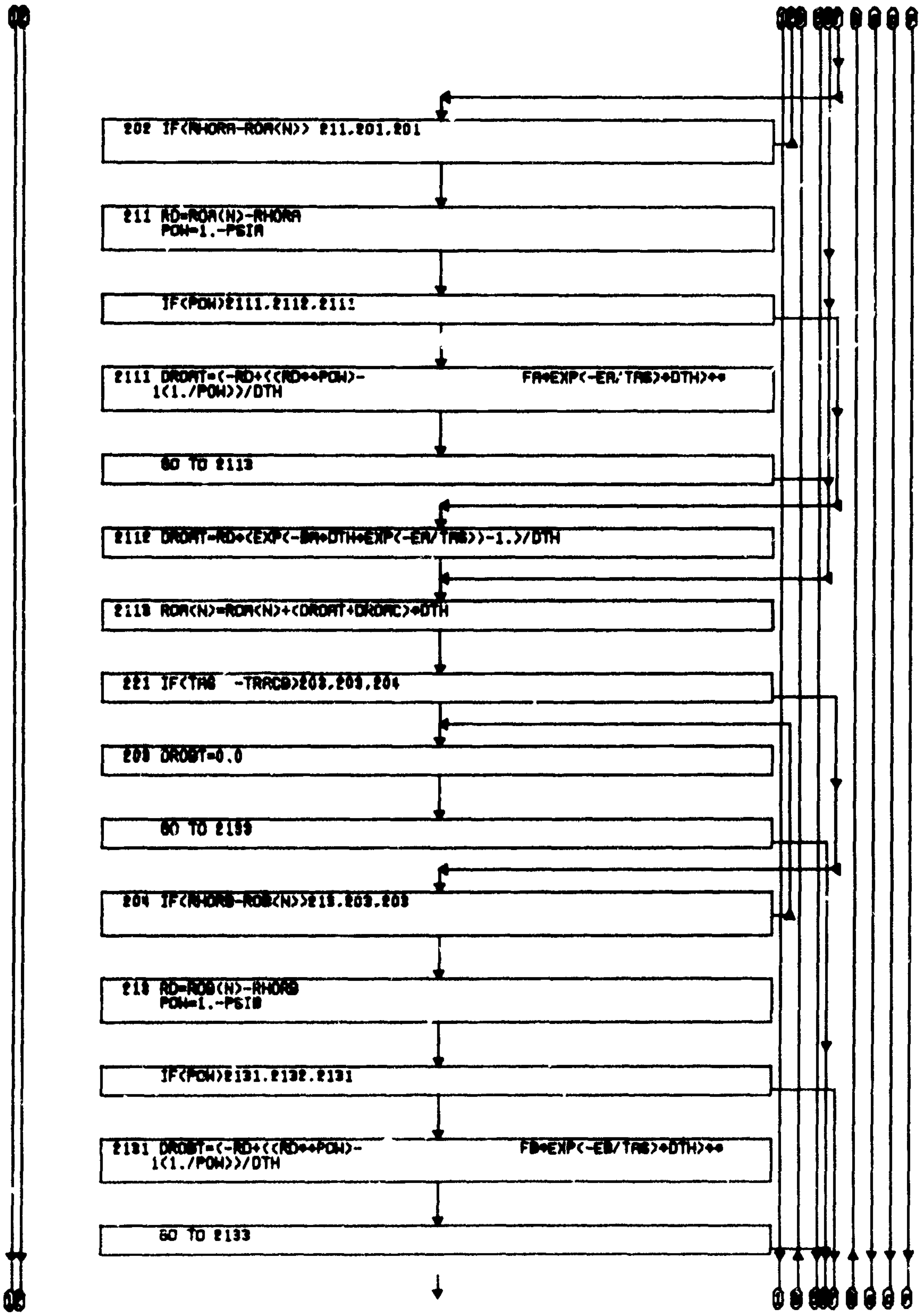
```
     ISV=MIN0(NL,I+1)
     DMDB(I)=0.0
     RON(I)=ROOZ
     DSS=FJF/DEL(I)*DSDT
     J2=J1
```

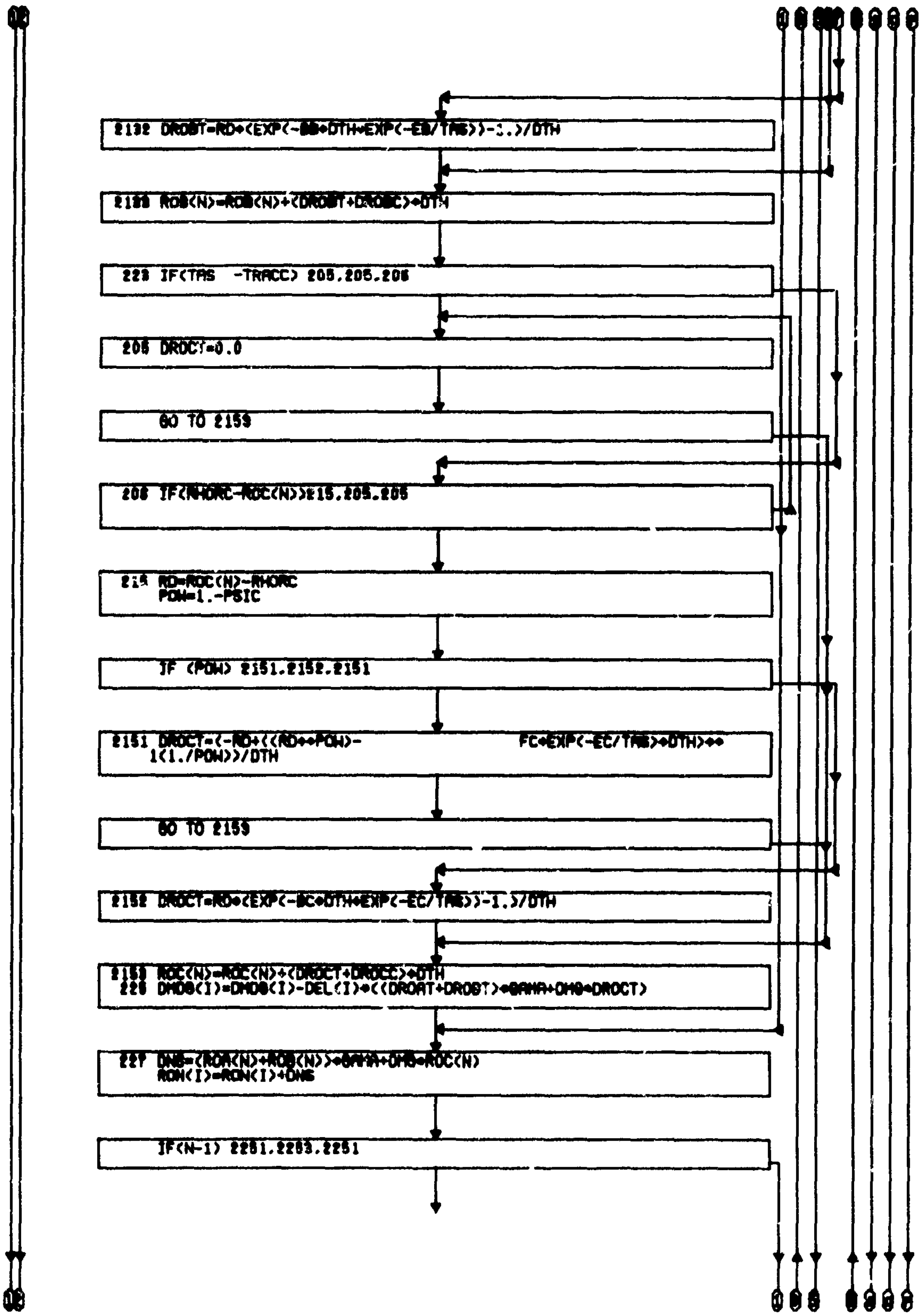
```
     DO 265 J=J2,JF
```

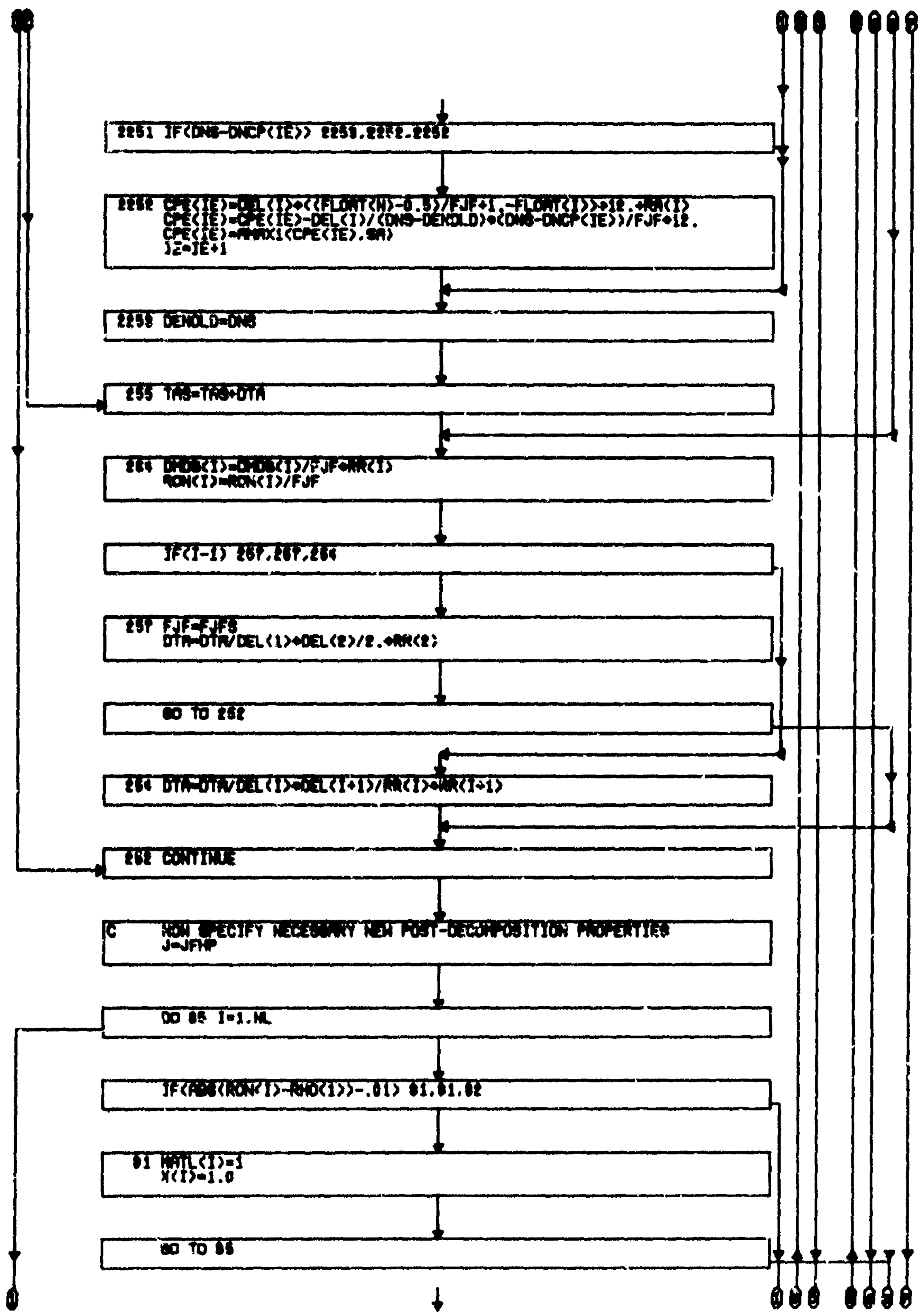

N=N+J1-1
IF (J-JFHP) 253.259.253
259 IF(MATL(I)+MATL(ISV)-4) 263.260.263
263 IF(AMAX1(TA(I).TA(I+1))-TRACH)261.261.262
261 IF(MATL(I)+MATL(I)+MATL(ISV)-3) 262.260.262
260 J1=JFHP
ROOZ=FJFH*RO(I+1)
RON(I)=RON(I)+FJFH*RO(I)
N=N+JFH
GO TO 264
262 ROOZ=0.0
J1=1
DTA=(TA(I+1)-TA(I))/(FJFS+FJF/DEL(I)+DEL(I+1)/RR(I)+RR(I+1))
TAS=TA(I)
253 N=N+1
IF(ABS(DSS)-.000001) 1016.1016.1017
1016 DROAC=0.
DROBC=0.
DROCC=0.
GO TO 1021
1017 IF(I-NL) 1015.1018.1015

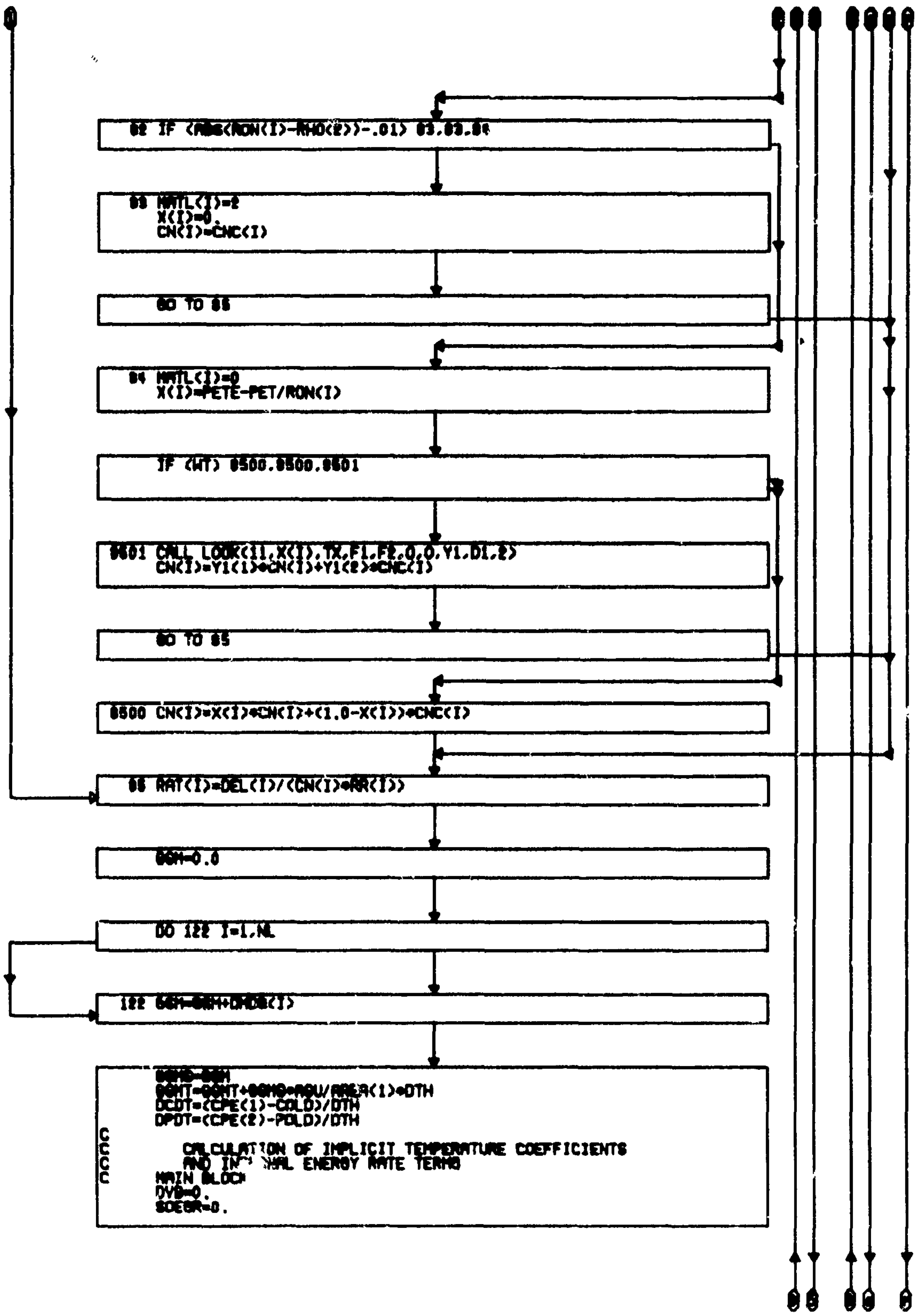


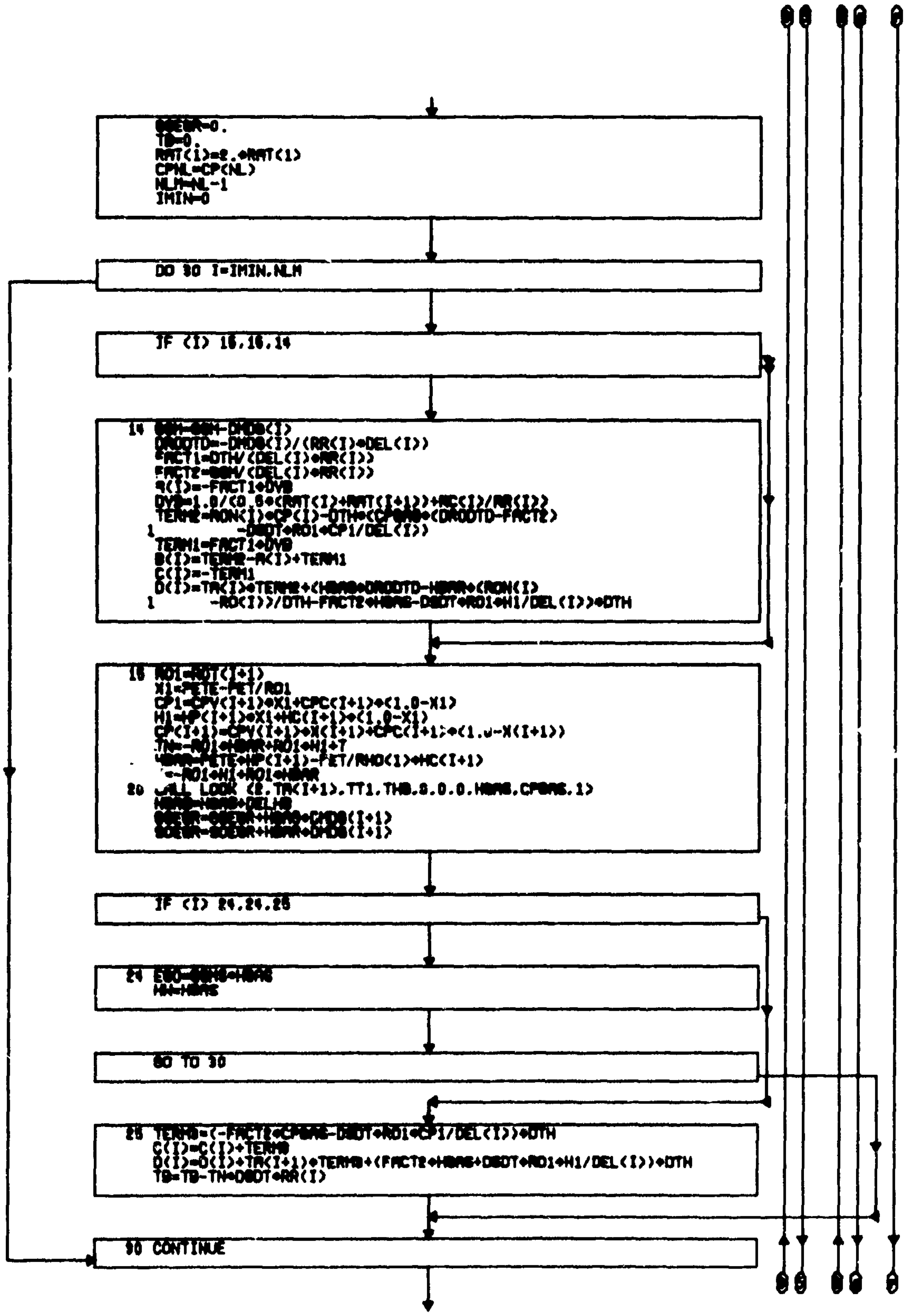
1019 FK=FK-1.0
IF(FK) 1019.1016.1020
1019 FK=FJF-1.G
1020 DSS=OSDT/DEL(I)*FK
1015 IF (N-1) 1115.1215.1115
1115 DRORC=(ROB(N+1)-ROR(N))*DSS
DROBC=(ROB(N+1)-ROB(N))*DSS
DROCC=(ROC(N+1)-ROC(N))*DSS
GO TO 1021
1216 CONTINUE
1315 DRORC=(ROR(N+1)-RHORA)*DSS
DROBC=(ROB(N+1)-RHORB)*DSS
DROCC=(ROC(N+1)-RHORC)*DSS
ROT(1)=RHO(2)
1021 TAS=TAS+DTA
IF(TAS-TRACM) 227,227,229
229 IF(TAS -TRACA) 201.201.202
201 DRORT=0.0
GO TO 2113

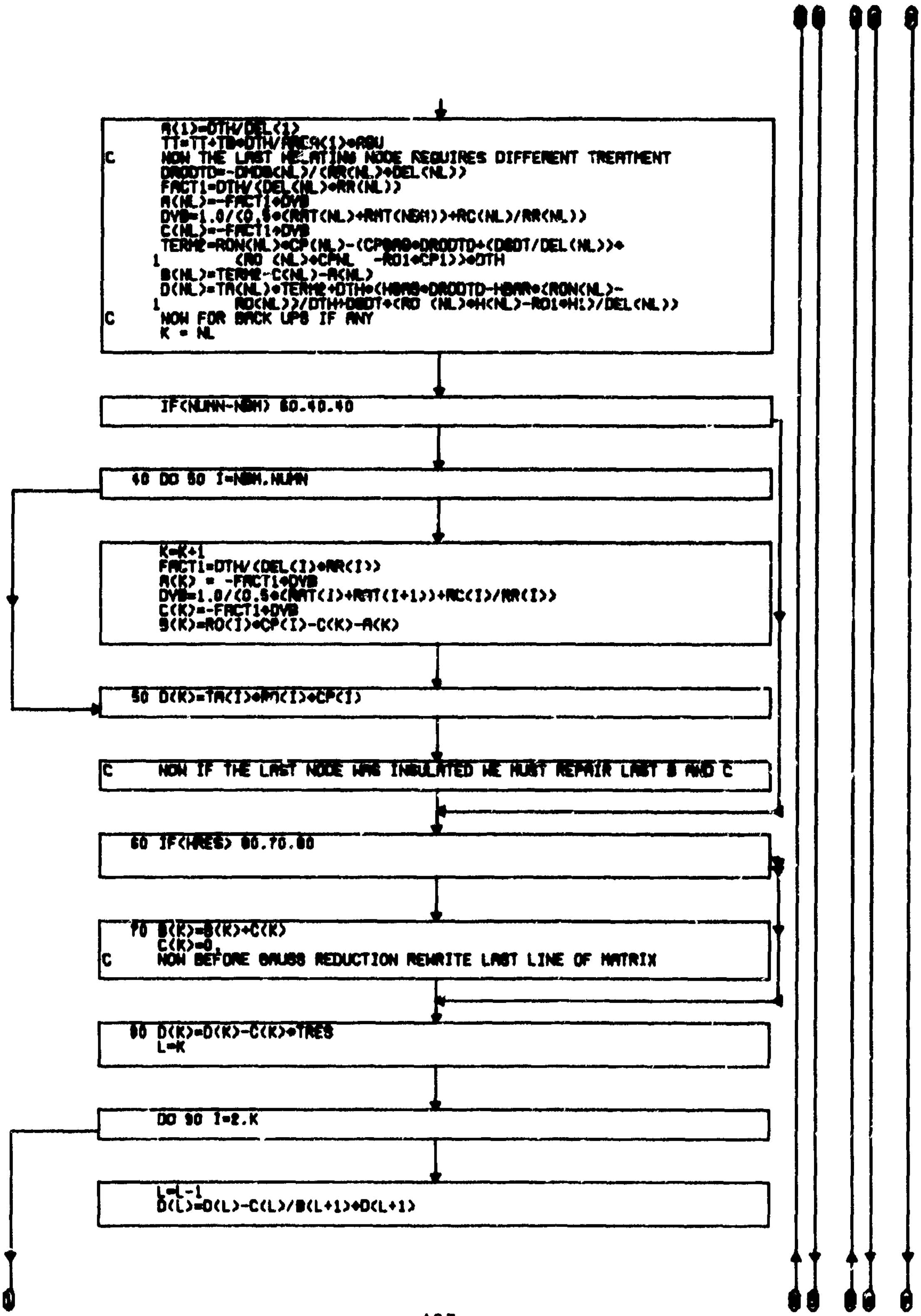

202 IF(RHORA-ROA(N)) 211,201,201
211 RD=ROA(N)-RHORA
POW=1.-PSIA
IF(POW)2111,2112,2111
2111 DROAT=(-RD+((RD**POW)-
1(1./POW))/DTH
FA*EXP(-EA/TAS)*DTH)**
GO TO 2113
2112 DROAT=RD*(EXP(-BA*DTH*EXP(-EA/TAS))-1.)/DTH
2113 ROA(N)=ROA(N)+(DROAT+DROAC)*DTH
221 IF(TAS -TRACB)203,203,204
203 DROBT=0.0
GO TO 2133
204 IF(RHORB-ROB(N))213,203,203
213 RD=ROB(N)-RHORB
POW=1.-PSIB
IF(POW)2131,2132,2131
2131 DROBT=(-RD+((RD**POW)-
1(1./POW))/DTH
FB*EXP(-EB/TAS)*DTH)**
GO TO 2133


2132 DROBT=RD*(EXP(-BB*DTH*EXP(-EB/TAS))-1.)/DTH
2133 ROB(N)=ROB(N)+(DROBT+DROBC)*DTH
223 IF(TAS -TRACC) 205,205,206
205 DROCT=0.0
GO TO 2153
206 IF(RHORC-ROC(N))215,205,205
215 RD=ROC(N)-RHORC
POW=1.-PSIC
IF (POW) 2151,2152,2151
2151 DROCT=(-RD+((RD**POW)- FC*EXP(-EC/TAS)*DTH)**
1(1./POW))/DTH
GO TO 2153
2152 DROCT=RD*(EXP(-BC*DTH*EXP(-EC/TAS))-1.)/DTH
2153 ROC(N)=ROC(N)+(DROCT+DROCC)*DTH
226 DMDG(I)=DMDG(I)-DEL(I)*((DROAT+DROBT)*GAMA+OMG*DROCT)
227 DNS=(ROA(N)+ROB(N))*GAMA+OMG*ROC(N)
RON(I)=RON(I)+DNS
IF(N-1) 2251,2253,2251


2251 IF(DNS-DNCP(IE)) 2253,2252,2252
2252 CPE(IE)=DEL(I)*((FLOAT(N)-0.5)/FJF+1.-FLOAT(I))*12.*RR(I)
CPE(IE)=CPE(IE)-DEL(I)/(DNS-DENOLD)*(DNS-DNCP(IE))/FJF*12.
CPE(IE)=AMAX1(CPE(IE),SA)
JE=JE+1
2253 DENOLD=DNS
255 TAS=TAS+DTA
264 DMDB(I)=DMDB(I)/FJF*RR(I)
RON(I)=RON(I)/FJF
IF(I-1) 257,257,254
257 FJF=FJFS
DTA=DTA/DEL(1)*DEL(2)/2.*RR(2)
GO TO 252
254 DTA=DTA/DEL(I)*DEL(I+1)/RR(I)*RR(I+1)
252 CONTINUE
C NOW SPECIFY NECESSARY NEW POST-DECOMPOSITION PROPERTIES
J=JFHP
DO 85 I=1,NL
IF(ABS(RON(I)-RHO(1))-.01) 81,81,82
81 MATL(I)=1
X(I)=1.0
GO TO 85


82 IF (ABS(RON(I)-RHO(2))-.01) 83,83,84
83 MATL(I)=2
X(I)=0.
CN(I)=CNC(I)
GO TO 85
84 MATL(I)=0
X(I)=PETE-PET/RON(I)
IF (WT) 8500,8500,8501
8501 CALL LOOK(11,X(I),TX,F1,F2,0,0,Y1,D1,2)
CN(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
GO TO 85
8500 CN(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
85 RAT(I)=DEL(I)/(CN(I)*RR(I))
GGM=0.0
DO 122 I=1,NL
122 GGM=GGM+DMDG(I)
GGMG=GGM
GGMT=GGMT+GGMG*AGU/AREA(1)*DTH
DCDT=(CPE(1)-COLD)/DTH
DPDT=(CPE(2)-POLD)/DTH
C
C CALCULATION OF IMPLICIT TEMPERATURE COEFFICIENTS
C AND INTERNAL ENERGY RATE TERMS
C MAIN BLOCK
DVB=0.
SOEGR=0.


SDEBR=0.
TB=0.
RAT(1)=2.*RAT(1)
CPNL=CP(NL)
NLM=NL-1
IMIN=0
DO 30 I=IMIN,NLM
IF (I) 16,16,14
14 SUM=SUM-DMDB(I)
DRODTD=-DMDB(I)/(RR(I)*DEL(I))
FACT1=DTH/(DEL(I)*RR(I))
FACT2=SUM/(DEL(I)*RR(I))
A(I)=-FACT1*DVB
DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
TERM2=RON(I)*CP(I)-DTH*(CPBAR*(DRODTD-FACT2)
1 -DBDT*RO1*CP1/DEL(I))
TERM1=FACT1*DVB
B(I)=TERM2-A(I)+TERM1
C(I)=-TERM1
D(I)=TA(I)*TERM2+(HBAR*DRODTD-HBAR*(RON(I)
1 -RO(I))/DTH-FACT2*HBAR-DBDT*RO1*H1/DEL(I))*DTH
16 RO1=ROT(I+1)
X1=PETE-PET/RO1
CP1=CPV(I+1)*X1+CPC(I+1)*(1.0-X1)
H1=HP(I+1)*X1+HC(I+1)*(1.0-X1)
CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
TN=-RO1*HBAR+RO1*H1+T
HBAR=PETE*HP(I+1)-PET/RHO(1)*HC(I+1)
*-RO1*H1+RO1*HBAR
20 CALL LOOK (2,TA(I+1),TT1,THB,0,0,0,HBAR,CPBAR,1)
HBAR=HBAR+DELHB
SDEBR=SDEBR+HBAR*DMDB(I+1)
SDEBR=SDEBR+HBAR*DMDB(I+1)
IF (I) 24,24,25
24 EBO=SUMB*HBAR
HH=HBAR
GO TO 30
25 TERMB=(-FACT2*CPBAR-DBDT*RO1*CP1/DEL(I))*DTH
C(I)=C(I)+TERMB
D(I)=D(I)+TA(I+1)*TERMB+(FACT2*HBAR+DBDT*RO1*H1/DEL(I))*DTH
TB=TB-TN*DBDT*RR(I)
30 CONTINUE


A(1)=DTH/DEL(1)
TT=TT+TB*DTH/AREA(1)*ASU
C NOW THE LAST HEATING NODE REQUIRES DIFFERENT TREATMENT
DRODTD=-DMDB(NL)/(RR(NL)*DEL(NL))
FACT1=DTH/(DEL(NL)*RR(NL))
A(NL)=-FACT1*DVB
DVB=1.0/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
C(NL)=-FACT1*DVB
TERM2=RON(NL)*CP(NL)-(CPBAR*DRODTD+(DBDT/DEL(NL))*
1 (RO (NL)*CPNL -RO1*CP1))*DTH
B(NL)=TERM2-C(NL)-A(NL)
D(NL)=TA(NL)*TERM2+DTH*(HBAR*DRODTD-HBAR*(RON(NL)-
1 RO(NL))/DTH+DBDT*(RO (NL)*H(NL)-RO1*H1)/DEL(NL))
C NOW FOR BACK UPS IF ANY
K = NL
IF(NUMN-NBM) 60.40.40
40 DO 50 I=NBM.NUMN
K=K+1
FACT1=DTH/(DEL(I)*RR(I))
A(K) = -FACT1*DVB
DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
C(K)=-FACT1*DVB
B(K)=RO(I)*CP(I)-C(K)-A(K)
50 D(K)=TA(I)*RM(I)*CP(I)
C NOW IF THE LAST NODE WAS INSULATED WE MUST REPAIR LAST B AND C
60 IF(HRES) 80.70.80
70 B(K)=B(K)+C(K)
C(K)=0.
C NOW BEFORE GAUSS REDUCTION REWRITE LAST LINE OF MATRIX
80 D(K)=D(K)-C(K)*TRES
L=K
DO 90 I=2.K
L=L-1
D(L)=D(L)-C(L)/B(L+1)*D(L+1)

```
   90 B(L)=B(L)-C(L)/B(L+1)*A(L+1)

      B(1)=B(1)/A(1)
      D(1)=D(1)/A(1)
      PGPU=EGO-GGEGR
      PGPUT=PGPUT+PGPU*DTH/AREA(1)*AGU
      DECOM=GGEGR-GOEGR
      DECOMT=DECOMT+DECOM*DTH/AREA(1)*AGU
C
C     SURFACE BOUNDARY CONDITION PACKAGE

  781 CALL SBCPKG
C

      IF(JCNA-2) 780.780.799

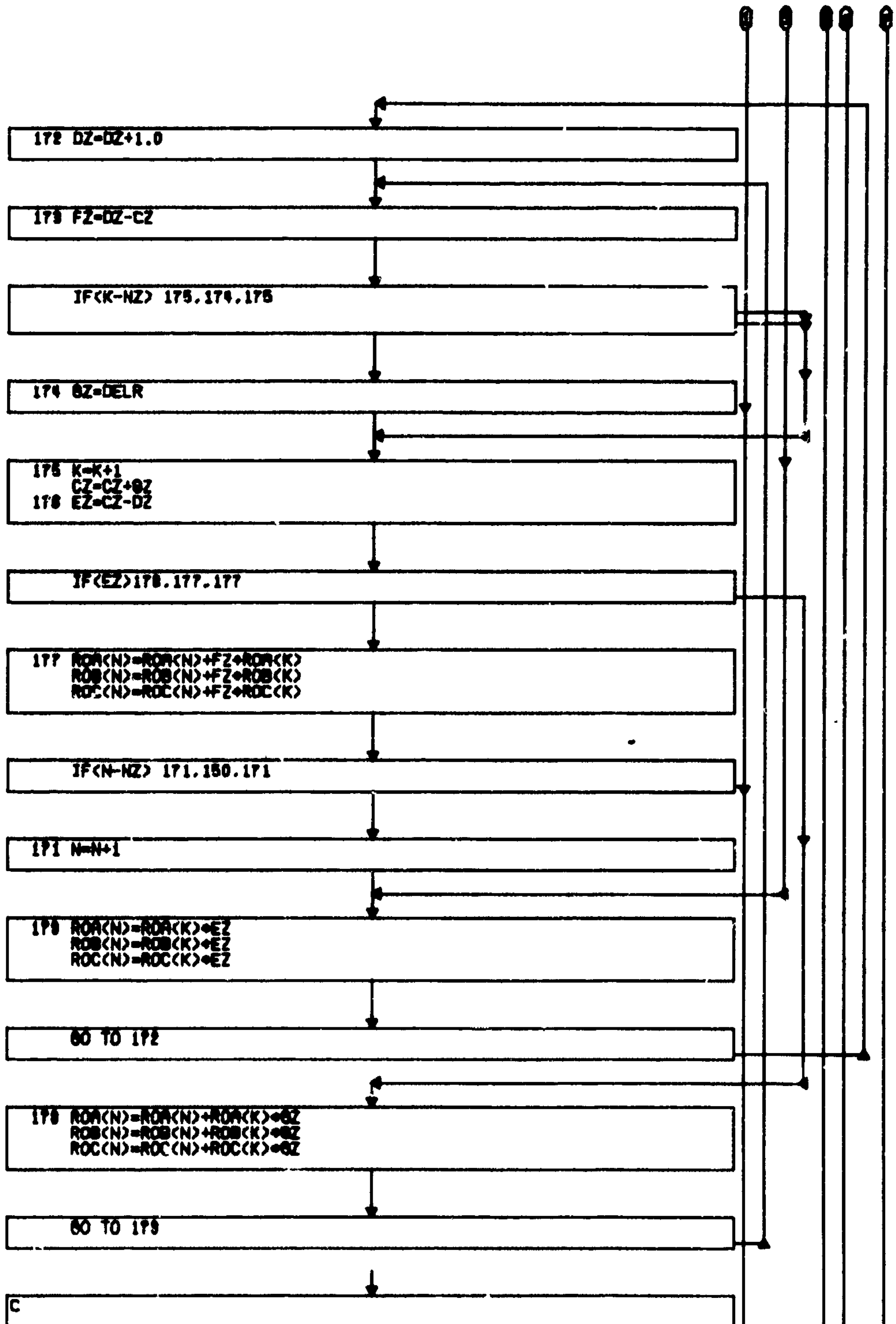
  780 IF(JCNA) 148.8088.148

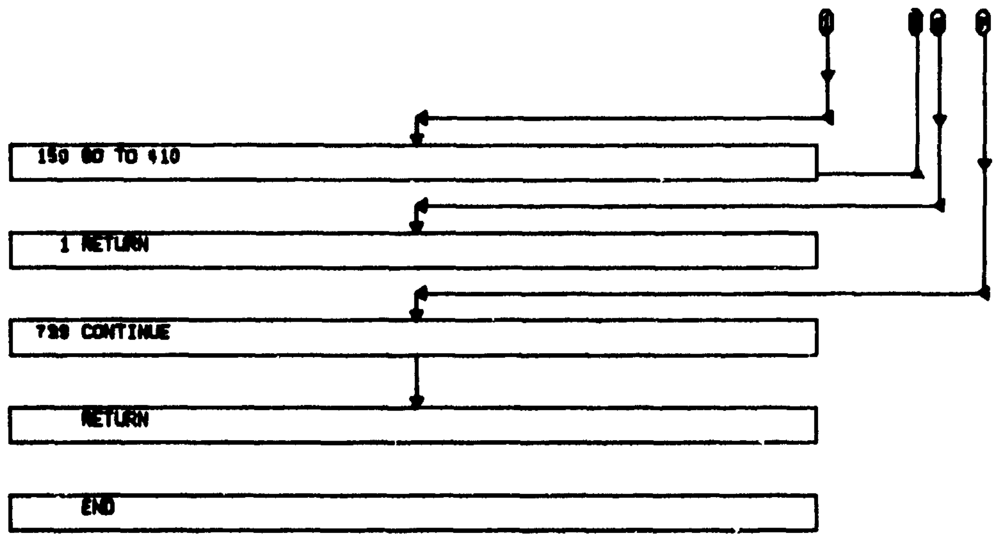
  148 CONTINUE
C
C     SHRINK (AND DROP) OF LAST ABLATING NODE
C
C     DEL(NL)=DEL(NL)-DS (SEE INT DECOMP)

      IF(DEL(NL)-DELM)149.149.180

  149 DALP=DEL(NL)*RO(NL)*RR(NL)
      DALCP=DALP*CP(NL)
      NL=NL-1
      RC(NL)=RC(NL+1)
      DAL=DEL(NL)*RO(NL)*RR(NL)
      DALC=DAL*CP(NL)
      HAPHB=DAL*H(NL)+DALP*H(NL+1)
      TOP1=DAL+DALP
      TOP2=DALC+DALCP
      TOP3=DALC*TR(NL) +DALCP*TR(NL+1)
      VOL=DEL(NL)*RR(NL)+DEL(NL+1)*RR(NL+1)
      DEL(NL)=DEL(NL)+DEL(NL+1)
      RO(NL)=TOP1/VOL
      CP(NL)=TOP2/TOP1
      TR(NL)=TOP3/TOP2
      H(NL)=HAPHB/TOP1
      DELR=DEL(NL+1)*RR(NL+1)/VOL
      CZ=1.0-DELR
      DZ=0.0
      GZ=CZ
      NZ=JF*NL-JFH
      N=NZ-JF+1
      K=N
      FZ=DELR
      EZ=GZ

      GO TO 179
```


172 DZ=DZ+1.0
173 FZ=DZ-CZ
IF(K-NZ) 175,174,175
174 BZ=DELR
175 K=K+1
CZ=CZ+BZ
176 EZ=CZ-DZ
IF(EZ)178,177,177
177 ROA(N)=ROA(N)+FZ*ROA(K)
ROB(N)=ROB(N)+FZ*ROB(K)
ROC(N)=ROC(N)+FZ*ROC(K)
IF(N-NZ) 171,180,171
171 N=N+1
179 ROA(N)=ROA(K)*EZ
ROB(N)=ROB(K)*EZ
ROC(N)=ROC(K)*EZ
GO TO 172
178 ROA(N)=ROA(N)+ROA(K)*BZ
ROB(N)=ROB(N)+ROB(K)*BZ
ROC(N)=ROC(N)+ROC(K)*BZ
GO TO 173
C


150 GO TO 410
1 RETURN
720 CONTINUE
RETURN
END

f. Subroutine INPOUT - B32A

(1) Function

Input/output routine for CMA. Called by CMA. Calls LCOUNT, SLOPQ, LOOK.

(2) Listing

```
      CB32A                                                             B32A 001
            SUBROUTINE INPOUT                                           B32A 002
            COMMON/CAMCOM/TLMC(20,10,2),TMG(20),TTS(20,10,2),TCHEM(20,10,2), B32A 003
           1NLO(20),NHI(20),KHI(20),JCMA,IMG,IMC,NMG,                   B32A 004
           2TCH(2),TPR(2),TRAD(2),IAB                                   B32A 005
           3,TT2(20,2),THZ(20,2),TT1(30),THG(30),DH12(2),TA(39),DELHG,I1,I2,CUB32A 006
           4,CMD,BPRMG,KCM(10)                                          B32A 007
            EQUIVALENCE (NCLASS,JCMA)                                   B32A 008
            COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)        B32A 009
            COMMON/CMACOM/TEP(20,2), TCP(20, 2),TKP(20, 2)              B32A 010
           3,RHO(2),MATL(38),DEL(39),SO(20),H(38),RC(38),RA(38),RECORD(36), B32A 011
           4AREA(38),EMA(38),RAV(38),                                   B32A 012
           5ROA(152),ROB(152),ROC(152),                                 B32A 013
           6    TPI(30),VFZ,CHH,NPR,                                    B32A 014
           7LCT, PG,II,NBM,NUMN,NL,        DELM,RFT,RHORA,RHORB,RHORC,TRA B32A 015
           8CA,TRACB,TRACC,RHOOA,RHOOB,RHOOC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,B32A 016
           9TRACN,PET,PETE,RSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WT B32A 017
            COMMON/CHACOM/EPSW,TRES,                                    B32A 018
           1TMWT,GAMA,OMG,NO,FJFH,FJFS,JF,JFHP,JFH,INPUT,      DTHIN,BRP,HCONV,B32A 019
           2INCH,DTHB,NN,NI,NOI,CHCRI,PYCRI,NCON,      NR,TX(30),F1(30),F2(30)  B32A 020
            COMMON/MISC/        BPRM,CMT,COLD,CP1,CPGAS,CPNL,CZ,DCDT,DECOM, B32A 021
           1DECOMT,DELCR,DELR,DENOLD,DIDT,DNS,DPDT,DRLCP,DRLC,DRLP,DRL,DROAC, B32A 022
           2DROAT,DROBC,DROBT,DROCC,DROCT,DRODTO,DSDT,DSI,DS,DSS,DTA,DTHC,DTHRB32A 023
           3,DTS,DVB,DZ,EGO,EZ,FACT1,FACT2,FA,FB,FC,FJF,FK,FZ,GSECR,GSM,GSMT, B32A 024
           4GZ,H1,HAPHB,HBAR,HGAS,HRES,IE,IMIN,I,IS,ISV,ITER,J1,J,KK,K,KT,L,  B32A 025
           5NOR,NLI,NLM,N,NZ,O,PGPU,PGPUT,PGLD,POW,QLOSS,QLOSST,RD,RO1,ROOZ,SAB32A 026
           6,SOEGR,TAS,TB,TERM1,TERM2,TERM3,THDS,TH,THPRT,TN,TOP1,TOP2,TOP3,T,B32A 027
           7TT,VOL,X1                                                   B32A 028
            EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)             B32A 029
            DIMENSION TNRY(20)                                          B32A 030
        497 FORMAT(I2,3F10.5)                                           B32A 033
        498 FORMAT(//7X,66HTABLE OF OPTIONAL MASS-FRACTION FUNCTIONS FOR THERMB32A 034
           1AL CONDUCTIVITY/25X,23HK = F1(X)*KP + F2(X)*KC//25X,1HX,12X,   B32A 035
           25HF1(X),10X,5HF2(X)//(13X,3(5X,F10.4)))                     B32A 036
        499 FORMAT(12A6)                                                B32A 037
        502 FORMAT (6X12A6)                                             B32A 038
        503 FORMAT(//24X31H---REACTION KINETIC EQUATION---/1H )         B32A 039
        504 FORMAT(10X67HDRHO/DTIME = GAMMA ( BA*EXP(-EA/T)RHOOA((RHOA-RHORA)/B32A 040
           1RHOOA)**PSIA )/   21X56H+ GAMMA ( BB*EXP(-EB/T)RHOOB((RHOB-RHORB)/B32A 041
           2RHOOB)**PSIB )/ 19X58H+(1-GAMMA)( BC*EXP(-EC/T)RHOOC((RHOC-RHORC)/B32A 042
           3RHOOC)**PSIC ))                                             B32A 043
        505 FORMAT (24X32H---REACTION KINETIC CONSTANTS---/1H )         B32A 044
        506 FORMAT (11X8HREACTION2X4HRHOO5X4HRHOR8X1HB7X3HPSI8X1HE6X6HT REAC/?B32A 045
           13X10H(LB/CU FT)6X7H(1/SEC)12X7H(DEG R' X7H(DEG R))         B32A 046
        507 FORMAT (14XA1,2X2F9.2,2XE10.4,F7.2,2XE10.4,F8.0)            B32A 047
        510 FORMAT(12X31HRESIN VOLUME FRACTION, GAMMA = F5.3,17H(MASS FRACTIONB32A 048
           1 = F5.3,1H)/1H )                                            B32A 049
        511 FORMAT (24X32H---TIME INCREMENT INFORMATION---/1H )         B32A 050
        512 FORMAT (6X18HINITIAL TIME (SEC)F7.3,26X16HFINAL TIME (SEC)F7.2)   B32A 051
        513 FORMAT (1H /6X17HOUTPUT INTERVAL =F6.3,1X27HSEC FROM INITIAL TIME B32A 052
           1UNTIL F7.3,4H SEC)                                          B32A 053
        514 FORMAT (6X17HOUTPUT INTERVAL =F6.3,1X8HSEC FROMF7.3,1X9HSEC UNTILFB32A 054
           17.3,4H SEC)                                                 B32A 055
        515 FORMAT (6X17HOUTPUT INTERVAL =F6.3,1X8HSEC FROMF7.3,1X20HSEC UNTILB32A 056
           1 FINAL TIME/1H )                                            B32A 057
        516 FORMAT (6X,19HMAXIMUM TIME STEP =,F4.2,8H SECONDS)          B32A 058
        517 FORMAT( /29X16H---NODAL DATA---/1H )                        B32A 059
        518 FORMAT(6X74HNODE  MATL  TEMPERATURE  RELATIVE  THICKNESS  NODAL DFB32A 060
```

```
    1PTH  CONT.RESISTANCE)
519 FORMAT(7X73HNO.   NO. (DEG.RANKINE)   AREA    (INCHES)    (INCHES)
   1   (SQFT-S-DEG/BTU))
520 FORMAT(5X2I6,F12.2,E13.4,F9.5,F12.6,A1,E15.4)
521 FORMAT (     14X47HMINIMUM THICKNESS OF LAST ABLATOR NODE (INCHES)F
   17.4/14X,19HTHERE ARE ,I2,40H NODELETS ASSIGNED TO EACH ABLATING NO
   2DE)
522 FORMAT(/15X48H---HEAT OF FORMATION OF MATERIAL CONSTITUENTS---/37X
   18H(BTU/LB)/21X7HPLASTIC11X4HCHAR17X3HGAS)
523 FORMAT (20XF9.2,7XF9.2,11XF9.2)
524 FORMAT(/7X28HENTHALPY DATUM TEMPERATURE =F9.3,1X11HDEG RANKINE)
525 FORMAT    (//22X36H---MATERIAL THERMAL PROPERTY DATA---//6X14HMATER
   1IAL NO. 110X14HMATERIAL NO. 210X26HMATERIAL NOS. 3 THROUGH 10/6X14
   2HVIRGIN PLASTIC15X4HCHAR23X7HBACK-UP)
526 FORMAT(/6X12HMATERIAL NO.I2,30X9HDENSITY =F8.3,1X8HLB/CU FT/
   1         7X11HTEMPERATURE5X13HSPECIFIC HEAT5X12HCONDUCTIVITY5X8HSEN
   2SIBLE4X10HEMISSIVITY/58X8HENTHALPY/9X7H(DEG R)7X12H(BTU/LB-DEG)4X1
   36H(BTU/FT-SEC-DEG)3X8H(BTU/LB)/
   4         (6XF8.2,8XF7.4,9XF10.7,7XF9.2,4XF7.4))
527 FORMAT(/6X12HMATERIAL NO.I2,30X9HDENSITY =F8.3,1X8HLB/CU FT/
   1         7X11HTEMPERATURE5X13HSPECIFIC HEAT5X12HCONDUCTIVITY/9X7H(D
   2EG R)7X12H(BTU/LB-DEG)4X16H(BTU/FT-SEC-DEG)/
   3         (6XF8.2,8XF7.4,9XF10.7))
528 FORMAT(39H  BAD SURFACE STATE TABLE  --  QUIT JOB  )
531 FORMAT (1H /6X19HTEMPERATURE (DEG R)5F11.2)
532 FORMAT    (//20X47H---RESIN DECOMPOSITION GAS SENSIBLE ENTHALPY---)
533 FORMAT       (6X19HENTHALPY   (BTU/LB)5F11.2)
534 FORMAT (1H //23X40H---TIME DEPENDENT BOUNDARY CONDITIONS---/1H )
535 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEAT
   15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,3X,8HENTHALPY,3X,
   29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/28X,8H(BTU/LB),2X,11H(BTU/S
   3Q FT-,1X,10H(LB/SQ FT-,3X,5H(ATM),3X,9HPARAMETER /40X,7HSECOND),
   44X,7HSECOND))
536 FORMAT (6X,F8.2,8X,I2,4X,2(F8.2,3X),F8.4,3X,F8.5,3X,F9.3)
537 FORMAT (1H /9X,69HCH/CHO = PHI/(EXP(PHI)-1.) WHERE PHI = 2.*BRP*M
   1DOT/CHO. BRP IN TABLE)
538 FORMAT(//27X30H---SURFACE EQUILIBRIUM DATA---)
539 FORMAT (1H /6X12HM DOT G/CM =F7.4/1H )
540 FORMAT(2(7X4HTEMP8X3HLOG7X9H(H WALL),3X)/2(6X7H(DEG R)3X10HM-DOT-C
   1/CM2X11H(1+B PRIME)2X)/2(29X8H(BTU/LB)4X))
541 FORMAT (5XF8.2,4XF7.4,5XF9.2,8XF8.2,4XF7.4,5XF9.2)
551 FORMAT(1H110X65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND A
   1BLATION PROGRAM/73X4HPAGEI3/1H 67X2A6)
552 FORMAT (9X,4HTIME,8X,4HPROB,3X,7HSURFACE,4X,7HSURFACE/9X,5H(SEC),
   17X,4HOPTN,5X,4HTEMP,5X,9HRECESSION/28X,7H(DEG R),6X,4HRATE/38X,
   210H(MILS/SEC))
553 FORMAT(8X24H*INITIAL INTERNAL RADIUS,1X,F6.3,4X,21HAREA PROP.TO RA
   1DIUS**F4.2)
554 FORMAT(8X24H*INITIAL EXTERNAL RADIUS,1X,F6.3,4X,21HAREA PROP.TO RA
   1DIUS**F4.2)
555 FORMAT(8X15H*PLANAR SURFACE)
556 FORMAT (9X,4HTIME,8X,4HPROB,5X,4HVIEW,5X,9HRADIATION/9X,5H(SEC),
   17X,4HOPTN,4X,6HFACTOR,4X,9HHEAT RATE/38X,11H(BTU/SQ FT-/40X,
   27HSECOND))
560 FORMAT(I2,5E10.0)
561 FORMAT (I2,F8.4)
563 FORMAT (I2,I3,I1,I2,I2,7F10.5/8F10.5)
564 FORMAT (A1,9X2F10.5,E10.3,F10.5,E10.3,F10.5)
571 FORMAT(I2,F10.5,F10.5,F10.8,F10.5)
575 FORMAT(I1,F9.5,7F10.5/8F10.5)
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```
  577 FORMAT(I1,F9.5,5F10.5)                                             B32A 121
  579 FORMAT(12X2E12.5,2E13.6,I1)                                        B32A 122
 5790 FORMAT (6X,26HNO RADIUS CORRECTION ON CH)                          B32A 123
 5791 FORMAT (3F8.5,F9.4,F5.3,2F9.3,I2,A6)                               B32A 124
 5792 FORMAT(//6X,3HP =,F9.4,4H ATM//6X,3(25HTEMPERATURE  EDGE ENTH   )/B32A 125
     16X,3(25H  (DEG R)     AT T-WALL    ))                              B32A 126
 5793 FORMAT (//6X,37HBAD SURFACE EQUILIBRIUM TABLE OF TYPE,I2)          B32A 127
 5794 FORMAT (//6X,74HEQUAL MASS AND HEAT TRANSFER COEFFICIENTS AND EQUAB32A 128
     1L DIFFUSION COEFFICIENTS/6X,29HNOMINAL SURFACE VIEW FACTOR =,      B32A 129
     2F6.3)                                                              B32A 130
 5789 FORMAT(//6X,14HM-DOT-GAS/CM =,F7.4,8X,10HPRESSURE =,F9.4,4H ATM// B32A 131
     17X,2(4HTEMP,5X,26HM-DOT-  CHEM.PROD  SURFACE,3X)/6X,2(36H(DEG R)  B32A 132
     2CHAR/CM   (8TU/LB)  SPECIES,2X))                                   B32A 133
 5795 FORMAT(5X,F8.2,2X,F7.4,2X,F8.2,4X,A6,1X,F8.2,2X,F7.4,2X,F8.2,4X,A6B32A 134
     1)                                                                  B32A 135
 5796 FORMAT (2F10.0,9X,I1)                                              B32A 136
 5797 FORMAT(//6X,45HRATIO OF MASS TO HEAT TRANSFER COEFFICIENTS =,F6.3/B32A 137
     1 6X,28HUNEQUAL DIFFUSION EXPONENT =,F6.3/6X,29HNOMINAL SURFACE VIEB32A 138
     2W FACTOR =,F6.3,11H (OPTION 1))                                    B32A 139
 5798 FORMAT                         (6X,F9.2,4X,F9.2,3X,F9.2,4X,F9.B32A 140
     22,3X,F9.2,4X,F9.2)                                                 B32A 141
 5799 FORMAT (6X,66HHEAT TRANSFER COEFFICIENT MULTIPLIED BY (R INITIAL/RB32A 142
     1 CURRENT)**1.8)                                                    B32A 143
  580 FORMAT (8F10.5)                                                    B32A 144
  581 FORMAT(/14X20HBACK WALL CONVECTION10X9HBACK WALL10X9HRESERVOIR/    B32A 145
     113X23HCOEF BTU/FTSQ-SEC-DEG R8X10HEMISSIVITY8X11HTEMPERATURE/      B32A 146
     217XF10.4,18XF6.3,10XF10.2)                                         B32A 147
  582 FORMAT(5F10.5,9X,I1)                                               B32A 148
      DATA  BLANK,ASTER/ 1H ,1H*/                                        B32A 149
      KOUT=5                                                             B32A 150
      INPUT=8                                                            B32A 151
      NMG=0                                                              B32A 152
      INCH=8                                                             B32A 153
      WT=0.0                                                             B32A 154
C     INPUT/OUTPUT                                                       B32A 155
C                                                                        B32A 156
    1 NPG=1                                                              B32A 157
      WRITE (KOUT,551)NPG                                                B32A 158
      READ  (INPUT,499)(RECORD(I),I=1,36)                                B32A 159
C                                                                   EUNITNB32A 160
C                                                                       POB32A 161
C                                                   8999,9999 )TUPNI.FOE(B32A 162
      WRITE (KOUT,502)(RECORD(I),I=1,36)                                 B32A 163
      WRITE (KOUT,503)                                                   B32A 164
      WRITE (KOUT,504)                                                   B32A 165
      WRITE (KOUT,505)                                                   B32A 166
      WRITE (KOUT,506)                                                   B32A 167
      READ  (INPUT,564)A9,RHOOA,RHORA,BA,PSIA,EA,TRACA,B9,RHOOB ,RHORB,BB32A 168
     1B,PSIB,EB,TRACB ,C9,RHOOC,RHORC,BC, PSIC,EC,TRACC                  B32A 169
      WRITE (KOUT,507)A9,RHOOA,RHORA,BA,PSIA,EA,TRACA,B9,RHOOB,RHORB,BB,B32A 170
     1PSIB,EB,TRACB ,C9,RHOOC,RHORC,BC, PSIC,EC,TRACC                    B32A 171
      READ (INPUT,563) JF,NUMN,NN,NO,NI,THZRO,THFIN,DTPRT,DTPR2,DTPR3,   B32A 172
     1DTHP,BRP,TPR2,TPR3,DELM,DH1,DH2,DELHG,GAMA,TZ                      B32A 173
      IF(JF-1) 171,170,172                                               B32A 174
  170 JF=2                                                               B32A 175
      GO TO 172                                                          B32A 176
  171 JF=10                                                              B32A 177
  172 JFH=JF/2                                                           B32A 178
      JF=JFH+JFH                                                         B32A 179
      JFHP=JFH+1                                                         B32A 180
```

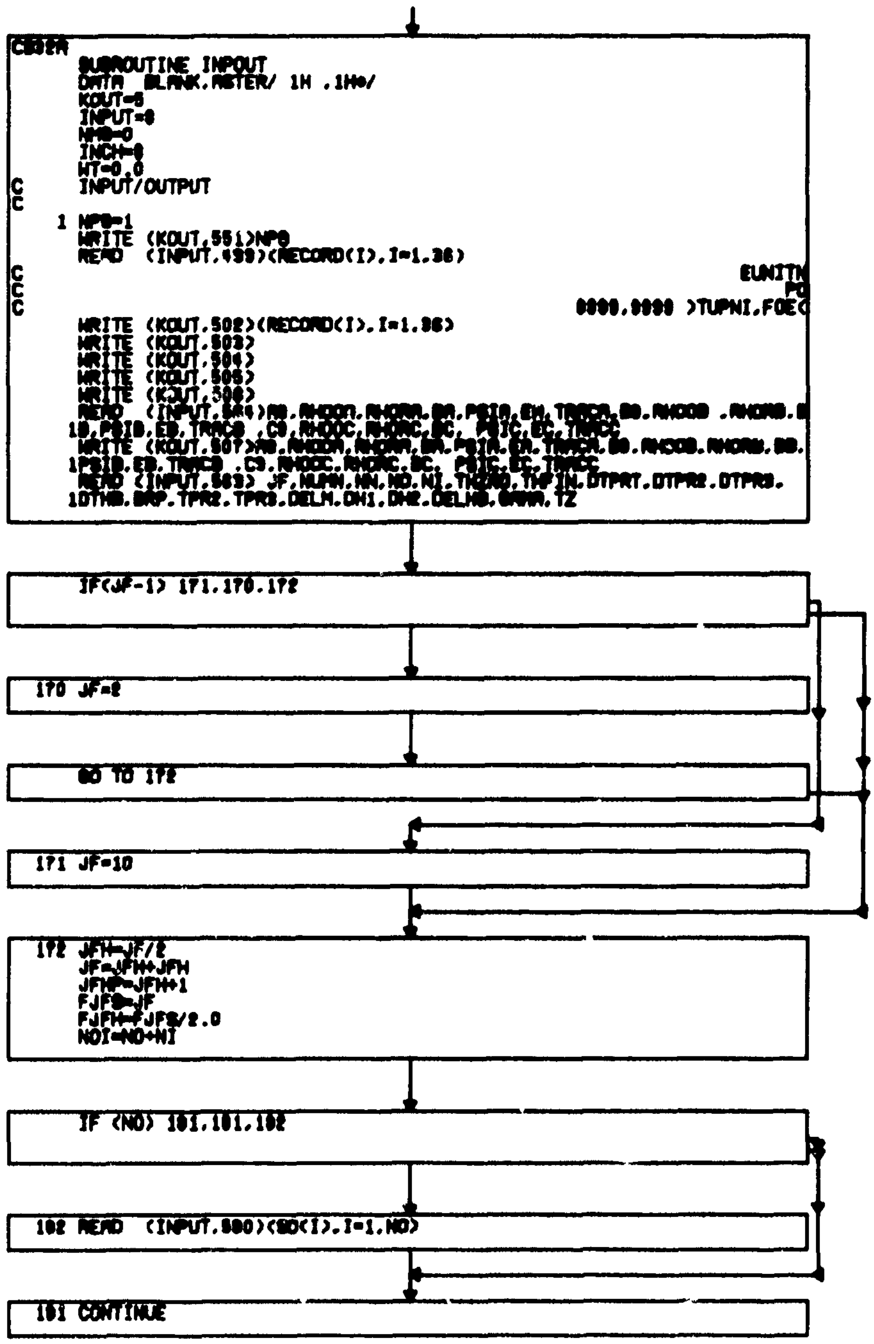
```
      FJFS=JF
      FJFH=FJFS/2.0
      NOI=NO+NI
      IF (NO) 181,181,182
  182 READ  (INPUT,580)(SO(I),I=1,NO)
  181 CONTINUE
      IF (NI) 184,184,183
  183 NOP=NO+1
      READ (INPUT,580) (SO(I), I=NOP,NOI)
  184 IF(GAMA) 408,409,409
  408 GAMA=RHOOC/(RHOOC-(RHOOA+RHOOB)-(RHOOA+RHOOB)/GAMA)
  409 OMG=1.0-GAMA
      RHO(1)=GAMA*(RHOOA+RHOOB)+OMG*RHOOC
      RHO(2)=GAMA*(RHORA+RHORB)+OMG*RHORC
      GAMAM=GAMA/RHO(1)*(RHOOA+RHOOB)
      WRITE (KOUT,510)GAMA,GAMAM
      IF(DTHB) 412,410,412
  410 DTHB=5.
  412 DTHIN=.01
  413 IF(TPR2)414,414,415
  414 TPR2=THFIN
  415 IF(TPR3)416,416,417
  416 TPR3=THFIN
      IF(TPR2-THZRO) 418,418,417
  418 DTPRT=DTPR2
      DTPR2=DTPR3
      TPR2=TPR3
      GO TO 416
  417 WRITE (KOUT,511)
      THFIN=AMAX1(THFIN,TPR2,TPR3)
      WRITE (KOUT,512)THZRO,THFIN
      WRITE (KOUT,513)DTPRT,TPR2
      WRITE (KOUT,514)DTPR2,TPR2,TPR3
      WRITE (KOUT,515)DTPR3,TPR3
      WRITE (KOUT,516) DTHB
C461                                          )CCART,RCART,ACART(FINIM=MC
      TRACM=AMIN1(TRACA,TRACB,TRACC)
      PETE=RHO(1)/(RHO(1)-RHO(2))
      PET=PETE*RHO(2)
C     ----------  NODAL PROPERTIES
      N=0
      J1=JFH
      CALL LCOUNT (-NUMN-8,LCT,NPG,RECORD(35))
  302 WRITE (KOUT,517)
      WRITE (KOUT,518)
      WRITE (KOUT,519)
      B=ASTER
      READ(INPUT,560)(MATL(I),TA(I),AREA(I),DEL(I),RA(I),RC(I),I=1,NUMN)
      AE=RA(2)
      RSV=RA(1)
      RA(1)=0.0
      DO 400 I=1,NUMN
      IF(I-2) 4541,452,453
  453 RA(I)=RA(I-1)+(DEL(I-1)+DEL(I))/2.0
      GO TO 461
  452 RA(2)=DEL(1)+DEL(2)/2.
      B=BLANK
  461 DEL(I-1)=DEL(I-1)/12.
 4541 RAV(I)=RA(I)
      IF(AE) 4542,4543,4542
```

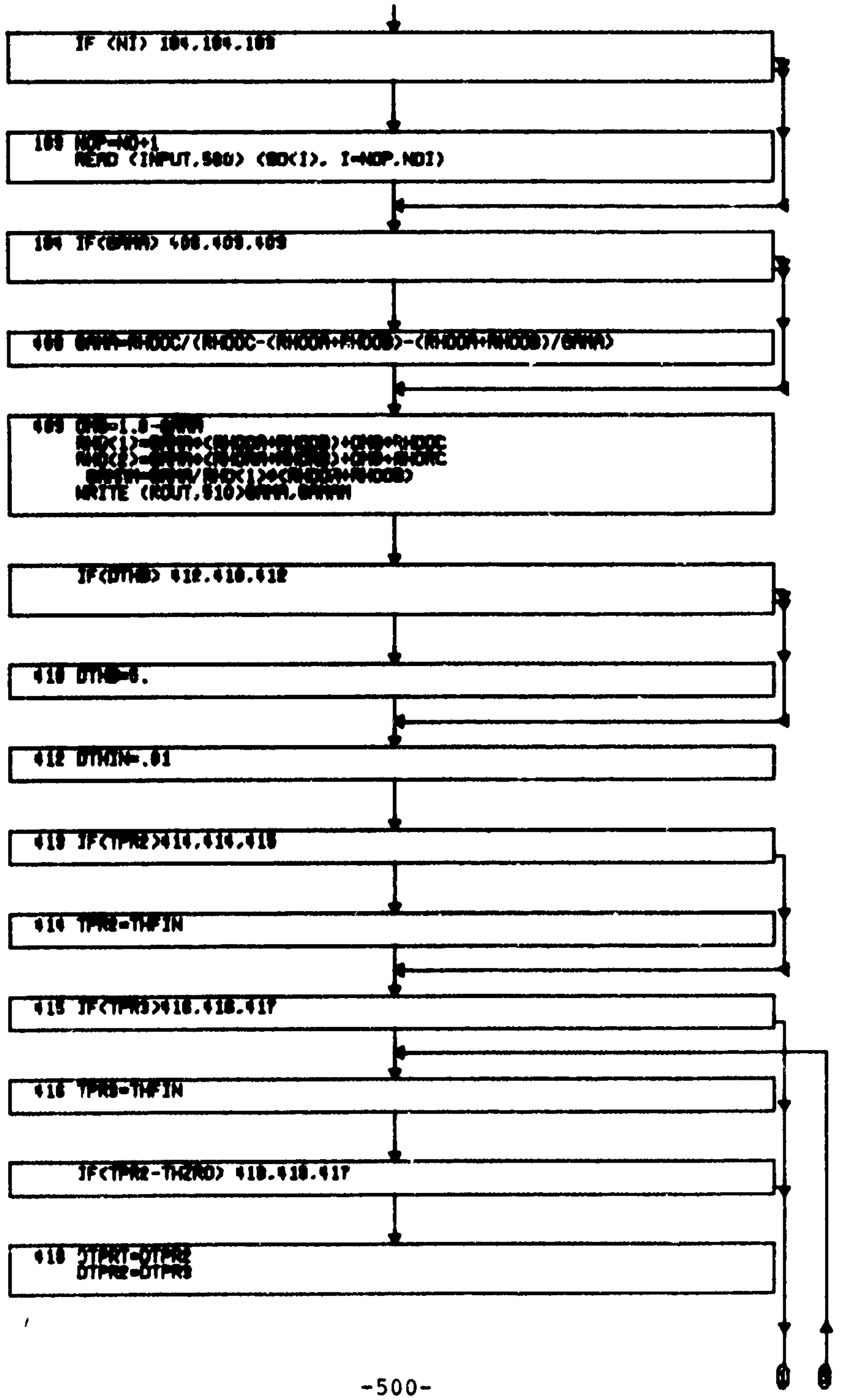
```
 4542 AREA(I)=(ABS(RSV+RA(I)))**AE
      GO TO 454
 4543 IF(AREA(I)) 4544,4544,454
 4544 IF(RSV) 4545,4546,4545
 4545 AREA(I)=ABS(RSV+RA(I))
      AE=1.0
      GO TO 454
 4546 AREA(I)=1.
  454 WRITE(KOUT,520)I,MATL(I),TA(I),AREA(I),DEL(I),RA(I),B,RC(I)
      IF(MATL(I)-2) 401,405,400
  401 NL=I
      DO 404 J=1,J1
      N=N+1
      ROA(N)=RHOOA
      ROB(N)=RHOOB
  404 ROC(N)=RHOOC
      J1=JF
      GO TO 400
  405 NL=I
      DO 406 J=1,J1
      N=N+1
      ROA(N)=RHORA
      ROB(N)=RHORB
  406 ROC(N)=RHORC
      J1=JF
  400 CONTINUE
  403 DEL(NUMN)=DEL(NUMN)/12.
      CALL SLOPU(NUMN,RA,AREA,EMA,EPA)
      NRM=NL+1
      IF(RSV) 4031,4032,4033
 4031 RSVN=-RSV
      WRITE(KOUT,554)RSVN,AE
      GO TO 304
 4032 WRITE(KOUT,555)
      GO TO 304
 4033 WRITE(KOUT,553)RSV,AE
  304 WRITE (KOUT,521) DELM,JF
      DELM=DELM/12.0
      READ(INPUT,582) HCONV,EPSW,TRES,CHCRI,PYCRI,NCON
      IF (CHCRI) 305,305,306
  305 CHCRI=0.02
  306 IF (PYCRI) 307,307,308
  307 PYCRI=0.98
  308 TA(NUMN+1)=TRES
      CALL LCOUNT(4             ,LCT,NPG,RECORD(35))
      WRITE(KOUT,581) HCONV,EPSW,TRES
      CALL LCOUNT(5             ,LCT,NPG,RECORD(35))
      WRITE (KOUT,522)
      WRITE (KOUT,523)DH1,DH2,DELHG
      CALL LCOUNT(2             ,LCT,NPG,RECORD(35))
      WRITE (KOUT,524)TZ
C     ----------  MATERIAL PROPERTIES
      CALL LCOUNT(6             ,LCT,NPG,RECORD(35))
  310 WRITE (KOUT,525)
      IT=0
      ILO(3)=1
      ILO(4)=1
      KT=1
  350 IT=IT+1
      READ (INPUT,571) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT),TEP(IT,KT)
```

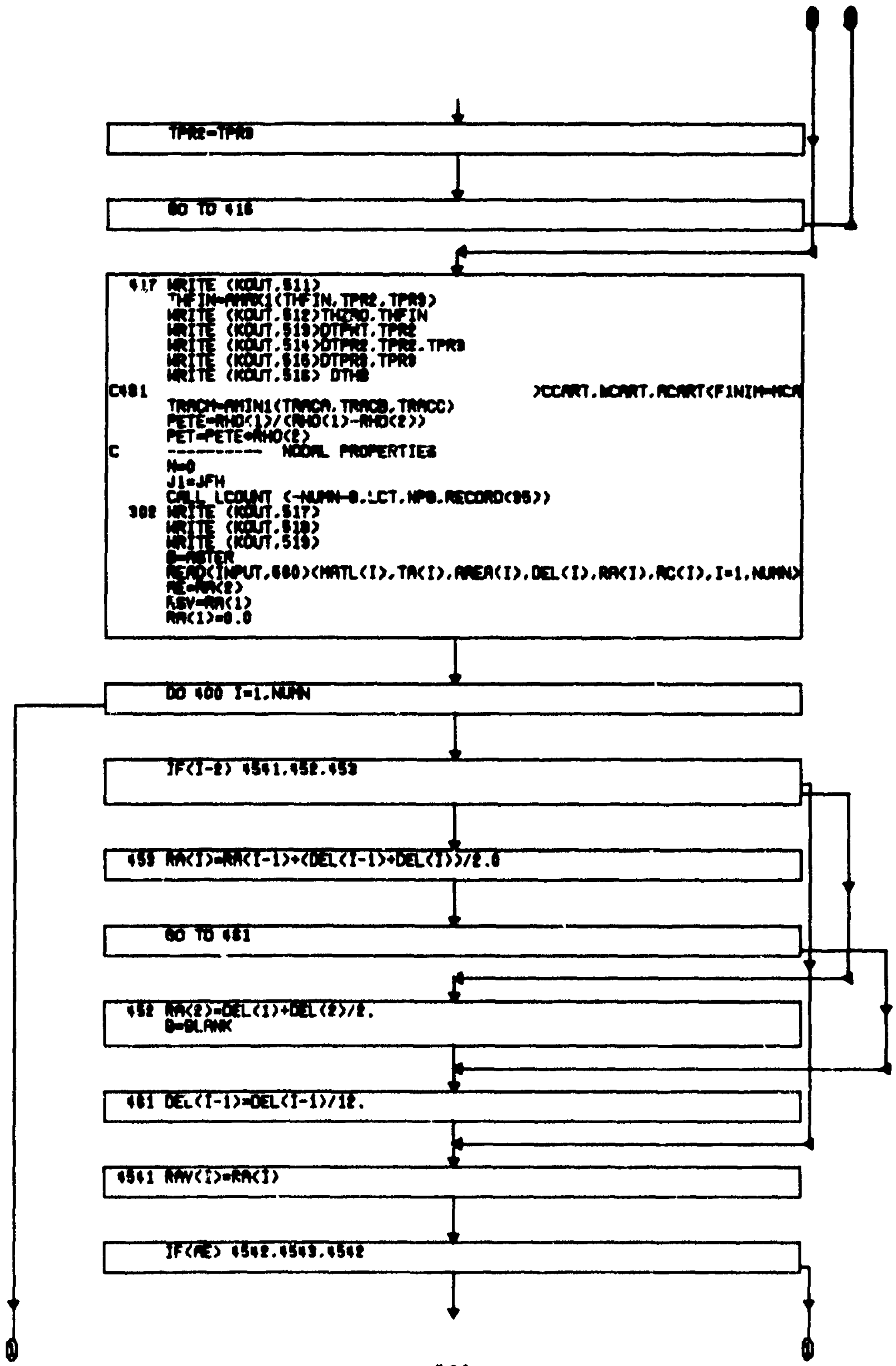
```
      IF(NC)351,350,351
  351 IHI(KT+2)=ILO(KT+2)+IT-1
      IR(KT+2)=ILO(KT+2)
      THZ(1,KT)=0.
      IF (IT-2) 2357,1357,1357
 1357 DO 357 I=2,IT
  357 THZ(I,KT)=THZ(I-1,KT)+(TCP(I,KT)+TCP(I-1,KT))/2.*(TT2(I,KT)-TT2(I-
     1I,KT))
 2357 CONTINUE
      CALL LOOK (KT+2,TZ,TT2(1,KT),THZ(1,KT),0,0,0,HSH,DUM,1)
      DO 359 I=1,IT
  359 THZ(I,KT)=THZ(I,KT)-HSH
      CALL LCOUNT(6+IT            ,LCT,NPG,RECORD(35))
  312 IF (IT-1) 2312,1312,1312
 1312 WRITE(KOUT,526)KT,RHO(KT),(TT2(I,KT),TCP(I,KT),TKP(I,KT),THZ(I,KT)
     1,TEP(I,KT),I=1,IT)
 2312 CONTINUE
      KT=KT+1
      IT=0
      IF(NC) 356,353,353
  356 IF(KT-2) 350,350,411
  411 READ (INPUT,561) KT,RHO(KT)
      IF (RHO(KT)) 3550,3550,355
 3550 KT=1,0
      IX=0
 3551 IX=IX+1
      READ (INPUT,497) NC,TX(IX), F1(IX),F2(IX)
      IF (NC) 3552,3551,3552
 3552 ILO(11)=1
      IHI(11)=IX
      IR(11)=1
      CALL LCOUNT(8+IX,LCT,NPG,RECORD(35))
      IF (IX-1) 6001,6000,6000
 6000 WRITE(KOUT,498) (TX(I),F1(I),F2(I),I=1,IX)
 6001 CONTINUE
      IF (NC) 411,411,353
  355 IT=IT+1
      READ (INPUT,571) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT)
      IF(NC) 354,355,354
  354 ILO(KT+2)=1
      IHI(KT+2)=ILO(KT+2)+IT-1
      IR(KT+2)=ILO(KT+2)
      CALL LCOUNT(5+IT            ,LCT,NPG,RECORD(35))
  314 IF (IT-1) 2314,1314,1314
 1314 WRITE (KOUT,527) KT,RHO(KT),(TT2(I,KT),TCP(I,KT),TKP(I,KT),I=1,IT)
 2314 CONTINUE
      IT=0
      IF(NC) 411,411,353
C     ----------  PYROLYSIS GAS ENTHALPY
  353 NT1=0
  341 IN=1+NT1
      NT1=N+NT1
      IF (NT1-IN) 6003,6002,6002
 6002 READ  (INPUT,575)NC,(TT1(I),I=IN,NT1),(THG(I),I=IN,NT1)
 6003 CONTINUE
      IF(NC)361,361,362
  364 NT1=NT1-1
  342 IF(TT1(NT1)) 364,364,365
  365 ILO(2)=1
      IR(2)=1
```

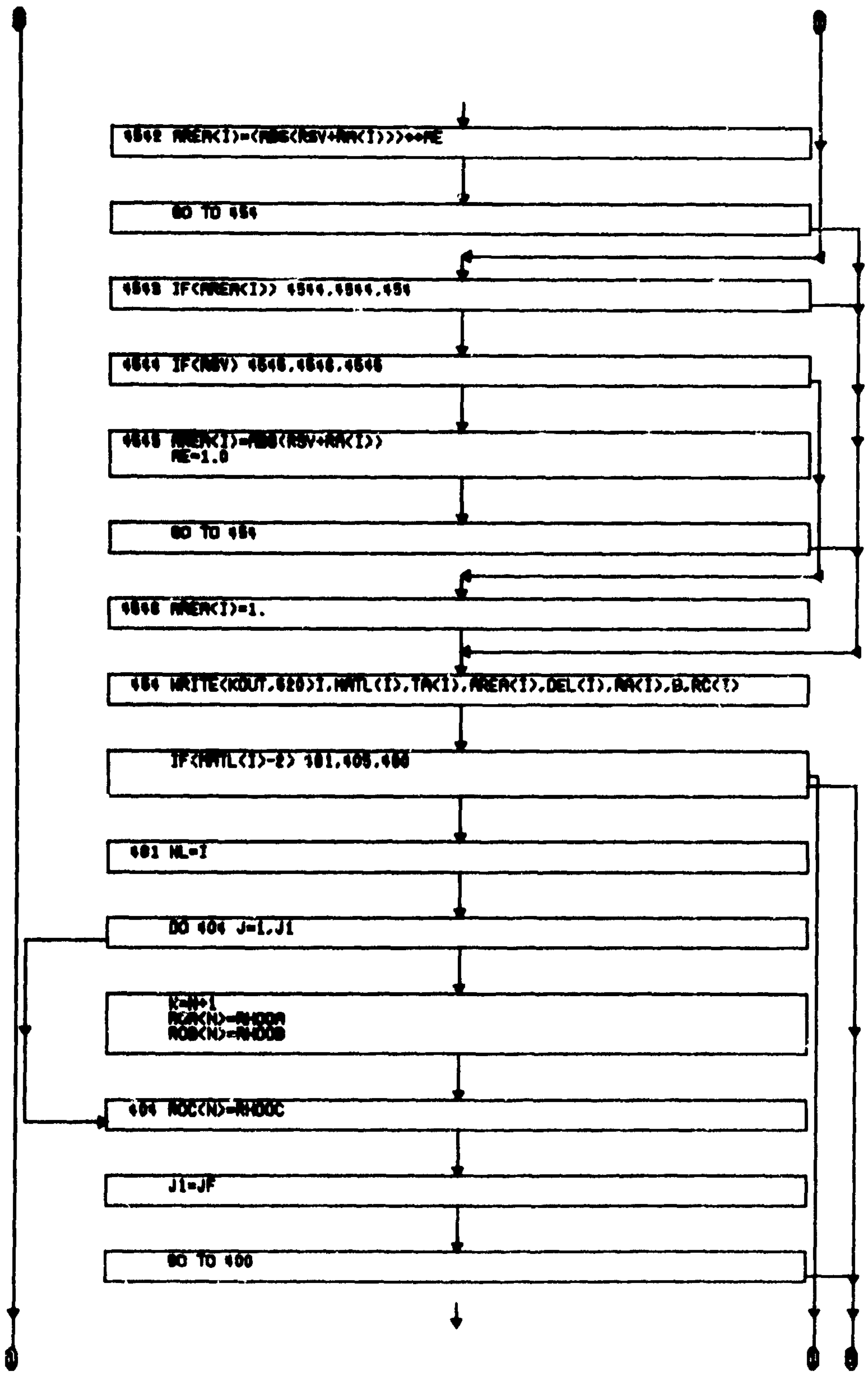
```
      IHI(2)=NT1                                                        B32A 361
      CALL LCOUNT(3*((NT1+9)/5),LCT,NPG,RECORD(35))                     B32A 362
  316 WRITE (KOUT,532)                                                  B32A 363
      IFN=0                                                             B32A 364
  366 IN=IFN+1                                                          B32A 365
      IFN=MIN0(NT1,IFN+5)                                               B32A 366
      IF (IFN-IN) 6005,6004,6004                                        B32A 367
 6004 WRITE (KOUT,531)(TT1(I),I=IN,IFN )                                B32A 368
      WRITE (KOUT,533)(THG(I),I=IN,IFN)                                 B32A 369
 6005 CONTINUE                                                          B32A 370
      IF(NT1-IFN) 367,367,366                                           B32A 371
  367 K=1                                                               B32A 372
 2803 READ(INPUT,583) BPG,(TNRY(I),I=1,19)                              B32A 373
      IF(TNRY(1)) 2804,2804,2805                                        B32A 374
 2805 TMG(K)=BPG                                                        B32A 375
      DO 2802 I=1,19                                                    B32A 376
      IF(TNRY(I)-29.) 2800,2800,2801                                    B32A 377
 2801 TTS(I,K,1)=TNRY(I)                                                B32A 378
      KHI(K)=I                                                          B32A 379
      NHI(K)=I
      GO TO 2802                                                        B32A 380
 2800 IF(TNRY(I)) 2811,2811,2810                                        B32A 381
 2810 TLMC(I,K,1) = TNRY(I)                                             B32A 382
      NHI(K)=I                                                          B32A 383
 2802 CONTINUE                                                          B32A 384
 2811 K=K+1                                                             B32A 385
      GO TO 2803                                                        B32A 386
 2804 NMG=K-1                                                           B32A 387
      IHI(12)=NMG                                                       B32A 388
      ILO(12)=1                                                         B32A 389
      IN(12)=1                                                          B32A 390
      DO 2818 K=1,NMG
      NLO(K)=KHI(K)+1                                                   B32A 392
      KHIK=KHI(K)                                                       B32A 393
      NLOK=NLO(K)                                                       B32A 394
      NHIK=NHI(K)                                                       B32A 395
      DO 2807 I=1,KHIK                                                  B32A 396
 2807 TTS(I,K,2)=TTS(I,K,1)                                             B32A 397
      IF(NHIK-NLOK) 2818,2809,2809
 2809 DO 2808 I=NLOK,NHIK
      TLMC(I,K,1)=ALOG(AMAX1(TLMC(I,K,1),.00001))                       B32A 399
 2808 TLMC(I,K,2)=TLMC(I,K,1)                                           B32A 400
 2818 CONTINUE
  583 FORMAT(20F4.0)                                                    B32A 401
      VFZ=1.0
      IF(BPG.GT.0.) VFZ=BPG
      RETURN
      END
```

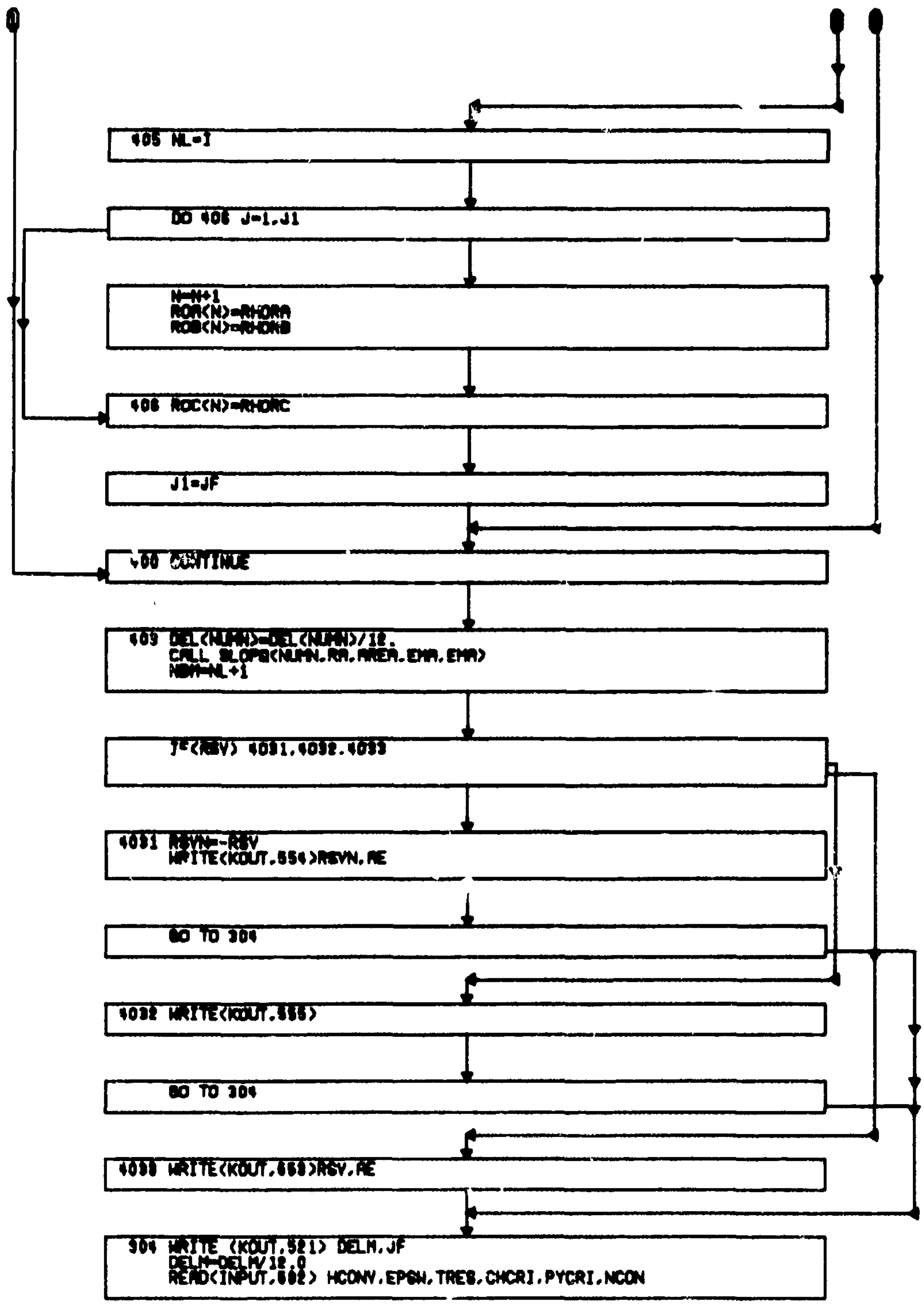
(3) Flow Chart

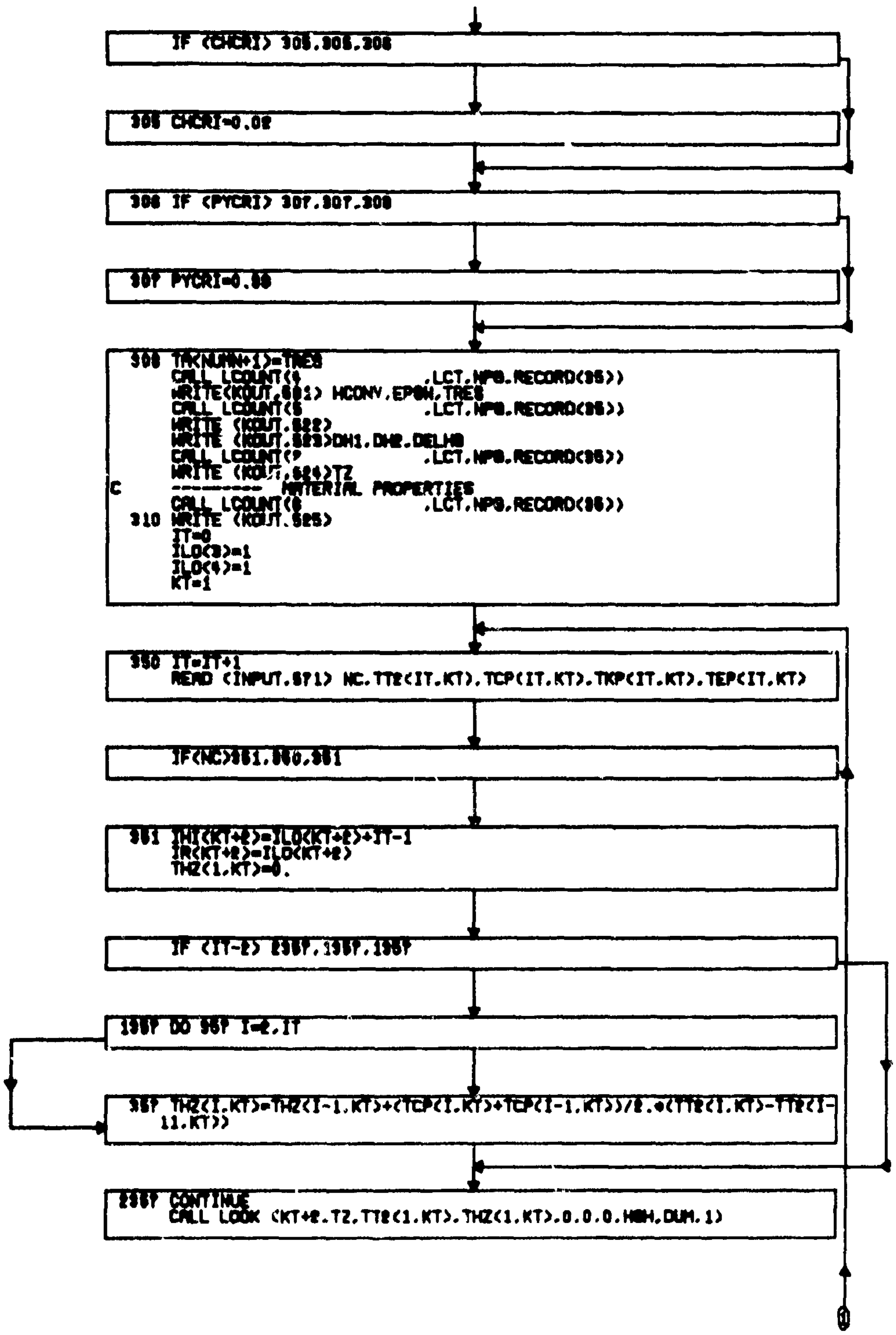

C302A
SUBROUTINE INPOUT
DATA BLANK.ASTER/ 1H .1H*/
KOUT=6
INPUT=8
NPB=0
INCH=8
WT=0.0
C INPUT/OUTPUT
C
1 NPB=1
WRITE (KOUT.551)NPB
READ (INPUT.499)(RECORD(I).I=1.36)
C EUNITN
C PO
C 8999.9999)TUPNI.FOE(
WRITE (KOUT.502)(RECORD(I).I=1.36)
WRITE (KOUT.503)
WRITE (KOUT.504)
WRITE (KOUT.505)
WRITE (KOUT.506)
IF(JF-1) 171.170.172
170 JF=2
GO TO 172
171 JF=10
172 JFH=JF/2
JF=JFH+JFH
JFHP=JFH+1
FJFS=JF
FJFH=FJFS/2.0
NOI=NO+NI
IF (NO) 181.181.182
182 READ (INPUT.880)(SO(I).I=1.NO)
181 CONTINUE

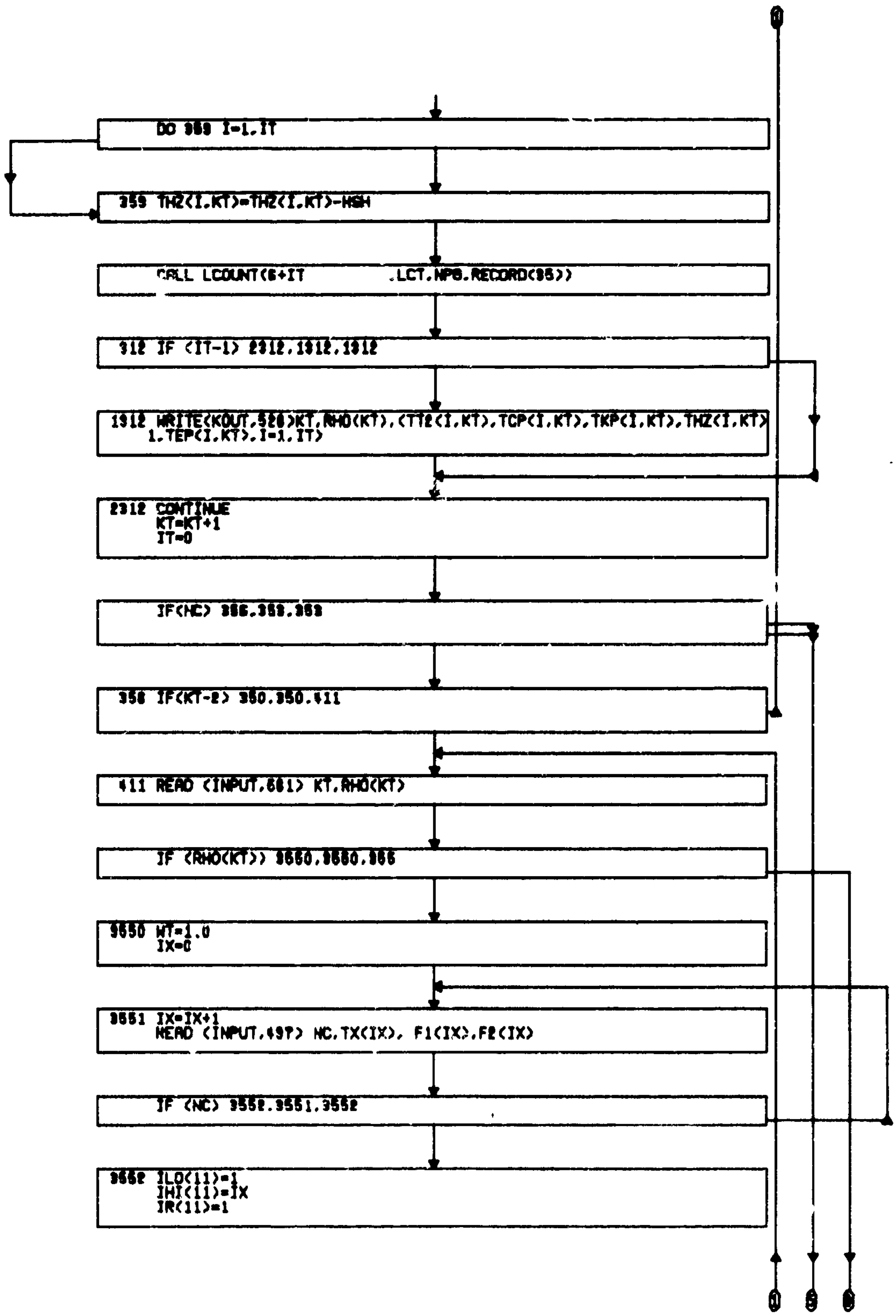

IF (NI) 104,104,103
103 NOP=NO+1
READ (INPUT,500) (SO(I), I=NOP,NDI)
104 IF(GAMA) 408,409,409
408 GAMA=RHOOC/(RHOOC-(RHOOA+RHOOB)-(RHOOA+RHOOB)/GAMA)
409 GMB=1.0-GAMA
WRITE (KOUT,510)GAMA,GAMAN
IF(DTHB) 412,410,412
410 DTHB=0.
412 DTHIN=.01
413 IF(TPR2)414,414,415
414 TPR2=THFIN
415 IF(TPR3)416,416,417
416 TPR3=THFIN
IF(TPR2-THZRO) 418,418,417
418 DTPR1=DTPR2
DTPR2=DTPR3

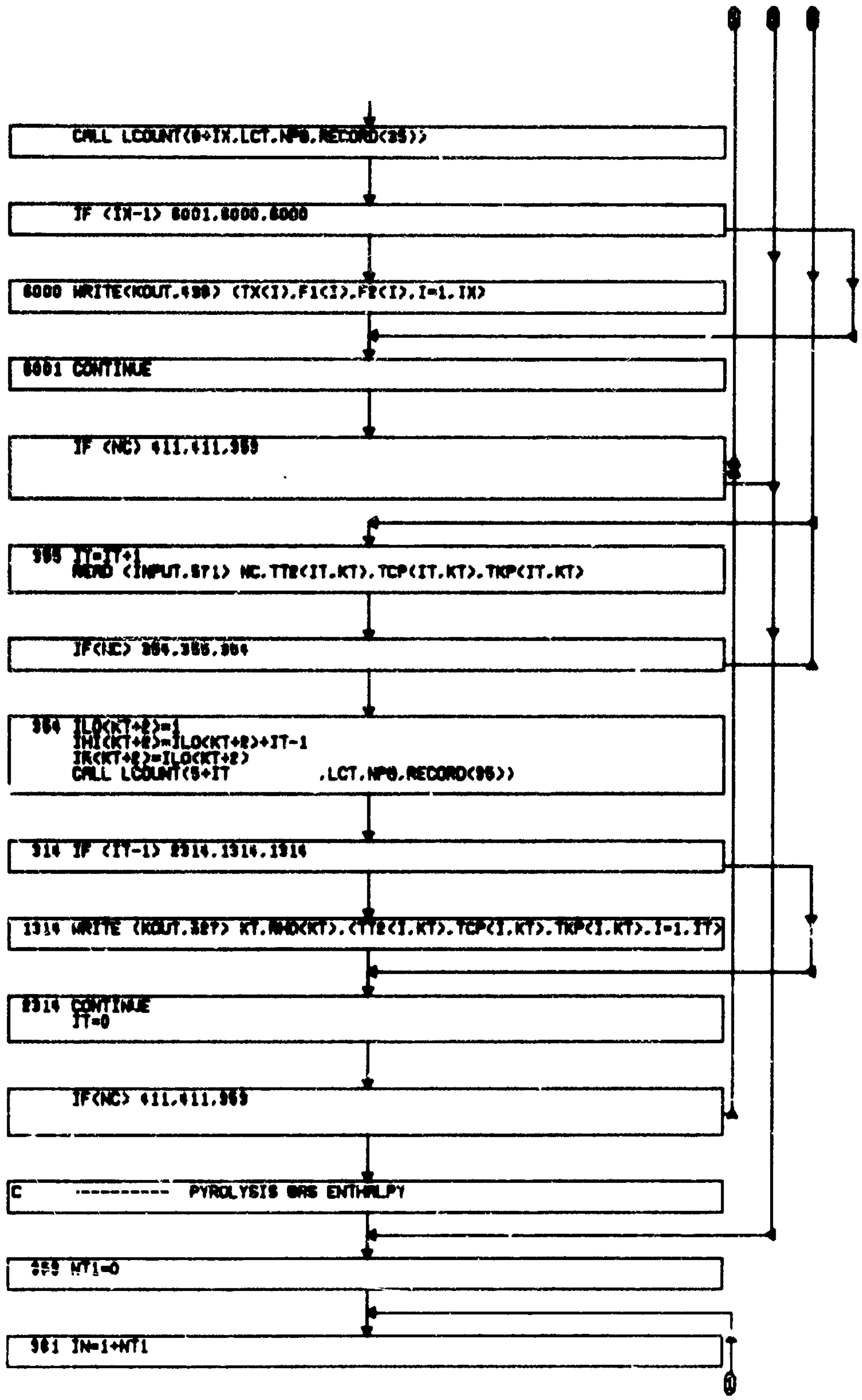

TPR2=TPR3
GO TO 416
417 WRITE (KOUT,511)
THFIN=AMAX1(THFIN,TPR2,TPR3)
WRITE (KOUT,512)THZRO,THFIN
WRITE (KOUT,513)DTPRT,TPR2
WRITE (KOUT,514)DTPR2,TPR2,TPR3
WRITE (KOUT,516)DTPR3,TPR3
WRITE (KOUT,515) DTHB
C481)CCART,BCART,ACART(F1NIM=NCA
TRACM=AMIN1(TRACA,TRACB,TRACC)
PETE=RHO(1)/(RHO(1)-RHO(2))
PET=PETE*RHO(2)
C ---------- NODAL PROPERTIES
N=0
J1=JFH
CALL LCOUNT (-NUMN-8,LCT,NPB,RECORD(95))
302 WRITE (KOUT,517)
WRITE (KOUT,518)
WRITE (KOUT,519)
B=ASTER
READ(INPUT,600)(MATL(I),TA(I),AREA(I),DEL(I),RA(I),RC(I),I=1,NUMN)
RE=RA(2)
RSV=RA(1)
RA(1)=0.0
DO 400 I=1,NUMN
IF(I-2) 4541,452,453
453 RA(I)=RA(I-1)+(DEL(I-1)+DEL(I))/2.0
GO TO 481
452 RA(2)=DEL(1)+DEL(2)/2.
B=BLANK
481 DEL(I-1)=DEL(I-1)/12.
4541 RAV(I)=RA(I)
IF(RE) 4542,4543,4542

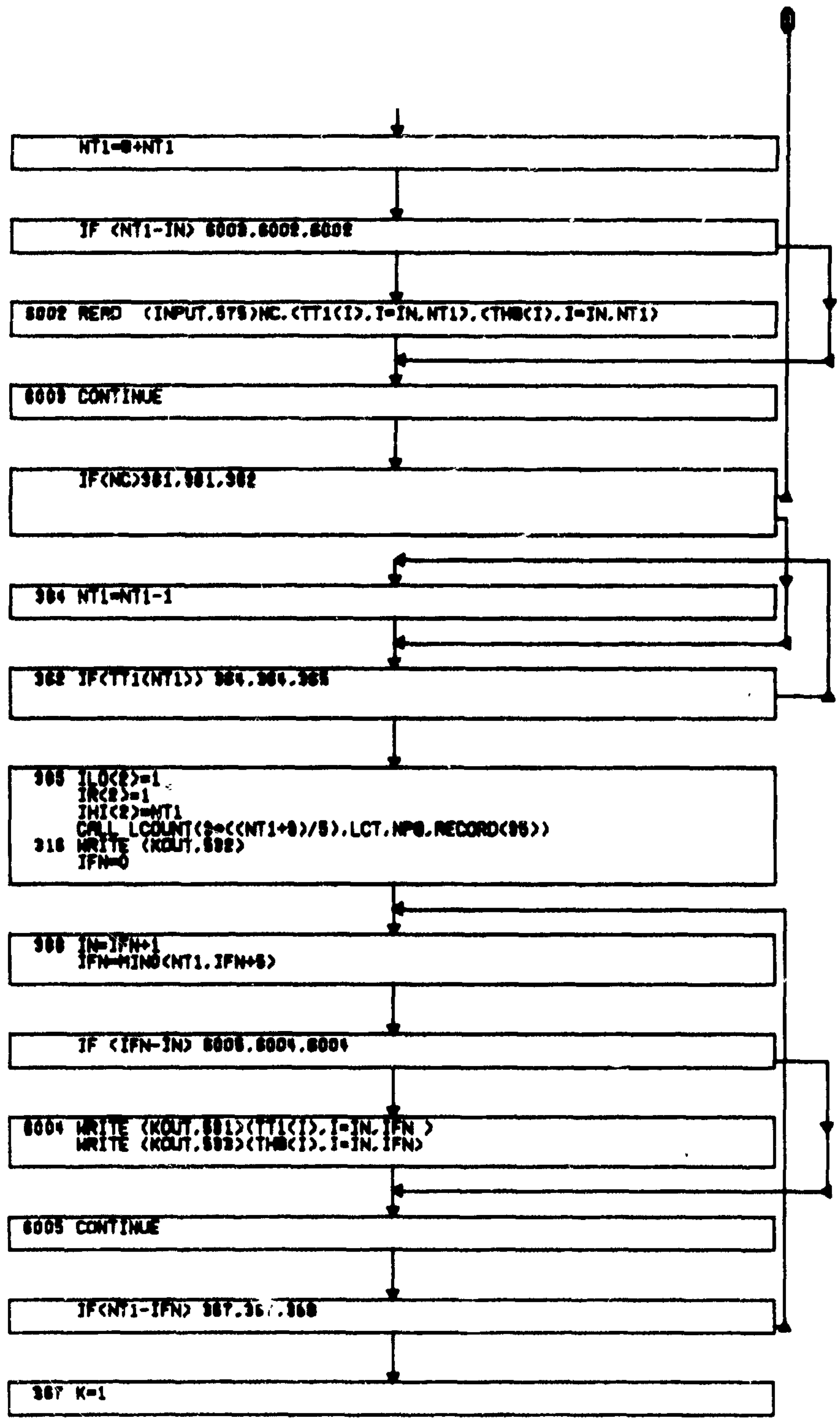

4542 AREA(I)=(ABS(RSV+RA(I)))**RE
GO TO 454
4543 IF(AREA(I)) 4544,4544,454
4544 IF(RSV) 4545,4546,4545
4545 AREA(I)=ABS(RSV+RA(I))
RE=1.0
GO TO 454
4546 AREA(I)=1.
454 WRITE(KOUT,620)I,MATL(I),TA(I),AREA(I),DEL(I),RA(I),B,RC(I)
IF(MATL(I)-2) 401,405,400
401 NL=I
DO 404 J=1,J1
N=N+1
ROA(N)=RHOOA
ROB(N)=RHOOB
404 ROC(N)=RHOOC
J1=JF
GO TO 400

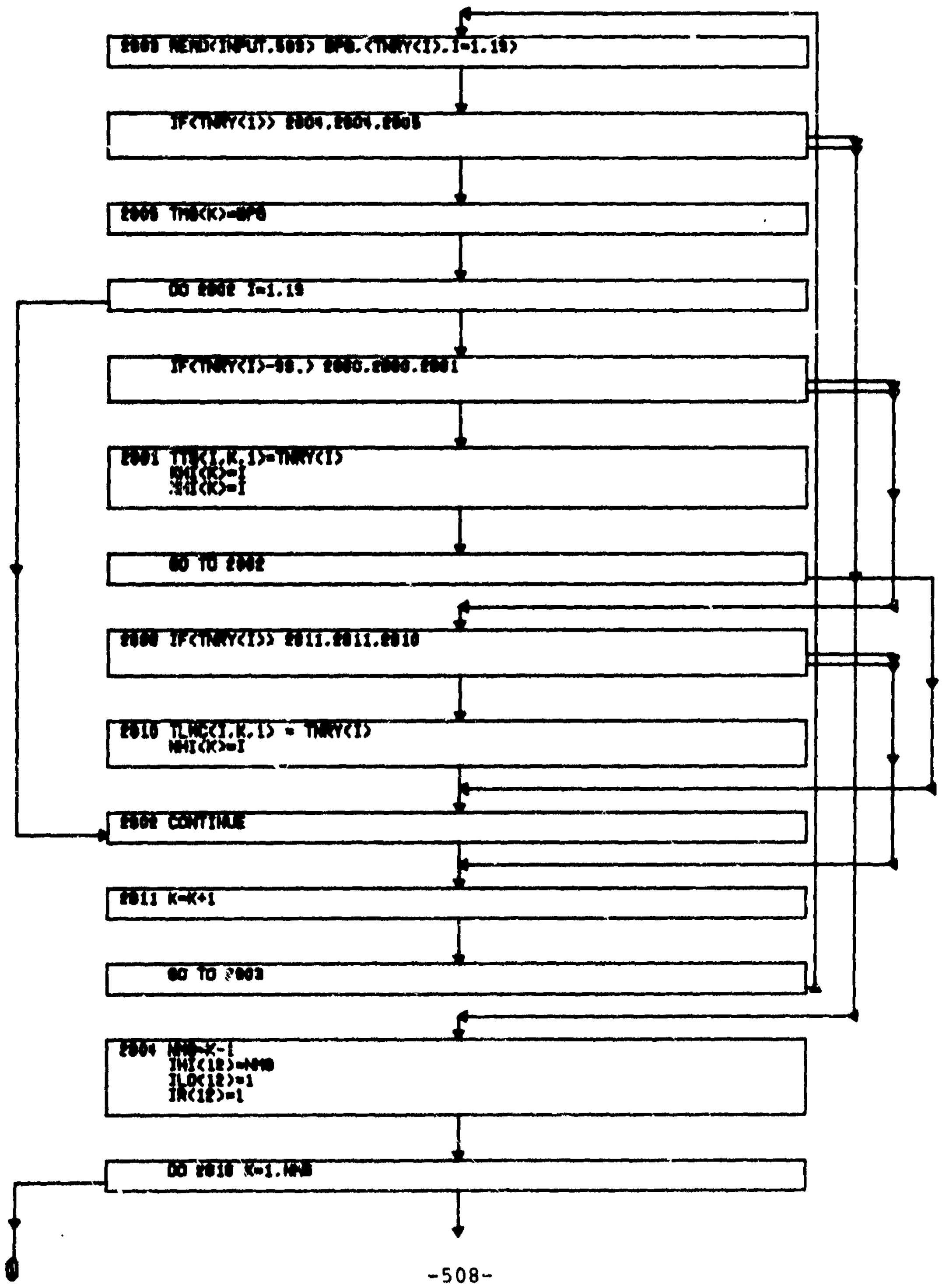

405 NL=1
DO 406 J=1,J1
N=N+1
ROA(N)=RHOAA
ROB(N)=RHOAB
406 ROC(N)=RHORC
J1=JF
400 CONTINUE
403 DEL(NUMN)=DEL(NUMN)/12.
CALL SLOPE(NUMN,RA,AREA,EMA,EMA)
NBM=NL+1
IF(RSV) 4031,4032,4033
4031 RSVN=-RSV
WRITE(KOUT,554)RSVN,RE
GO TO 304
4032 WRITE(KOUT,555)
GO TO 304
4033 WRITE(KOUT,553)RSV,RE
304 WRITE (KOUT,521) DELM,JF
DELM=DELM/12.0
READ(INPUT,602) HCONV,EPSW,TRES,CHCRI,PYCRI,NCON

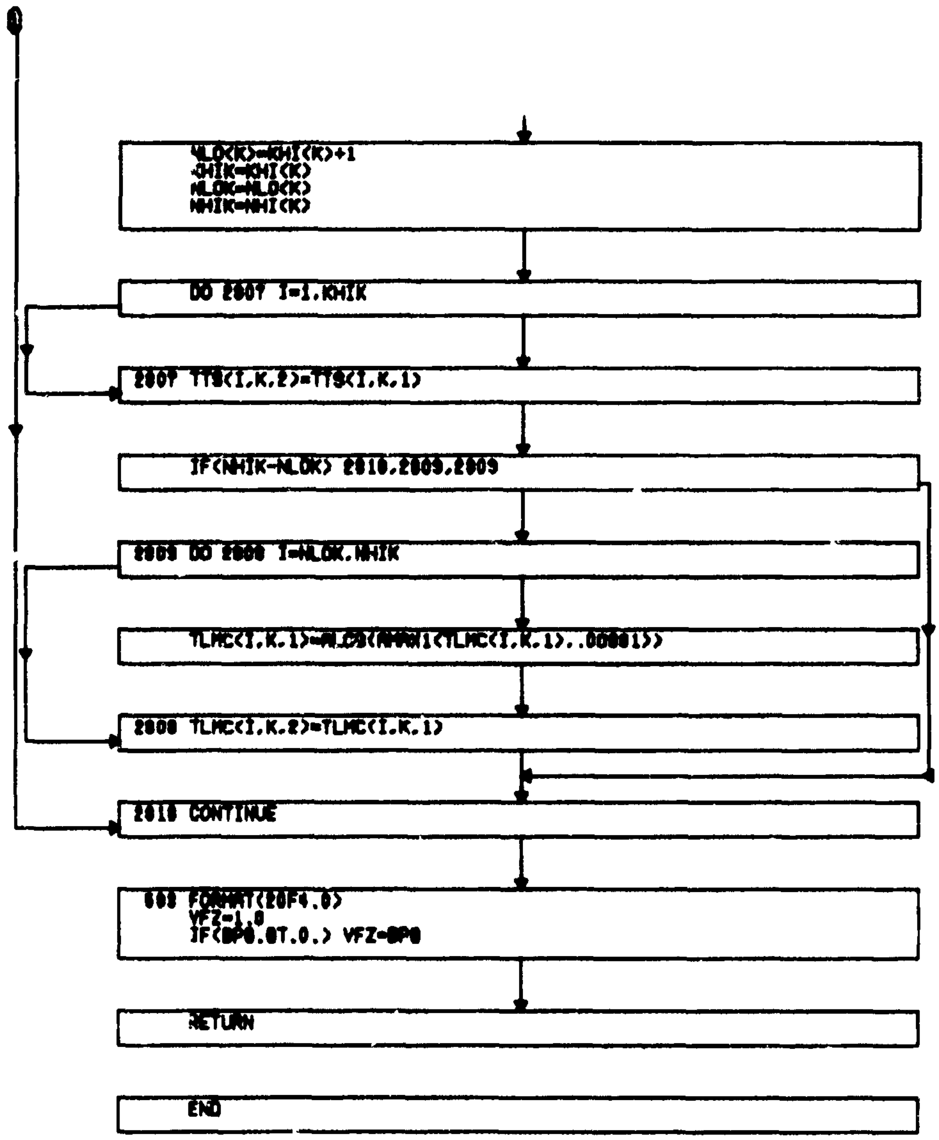

IF (CHCRI) 305,305,306
305 CHCRI=0.02
306 IF (PYCRI) 307,307,308
307 PYCRI=0.30
308 TA(NUMN+1)=TRES
CALL LCOUNT(4 ,LCT,NPG,RECORD(35))
WRITE(KOUT,621) HCONV,EPSH,TRES
CALL LCOUNT(5 ,LCT,NPG,RECORD(35))
WRITE (KOUT,622)
WRITE (KOUT,623)DH1,DH2,DELHB
CALL LCOUNT(7 ,LCT,NPG,RECORD(35))
WRITE (KOUT,624)TZ
C --------- MATERIAL PROPERTIES
CALL LCOUNT(6 ,LCT,NPG,RECORD(35))
310 WRITE (KOUT,625)
IT=0
ILO(3)=1
ILO(4)=1
KT=1
350 IT=IT+1
READ (INPUT,671) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT),TEP(IT,KT)
IF(NC)351,350,351
351 IHI(KT+2)=ILO(KT+2)+IT-1
IR(KT+2)=ILO(KT+2)
THZ(1,KT)=0.
IF (IT-2) 2357,1357,1357
1357 DO 357 I=2,IT
357 THZ(I,KT)=THZ(I-1,KT)+(TCP(I,KT)+TCP(I-1,KT))/2.*(TT2(I,KT)-TT2(I-1,KT))
2357 CONTINUE
CALL LOOK (KT+2,TZ,TT2(1,KT),THZ(1,KT),0,0,0,HGH,DUM,1)
1


DO 359 I=1,IT
359 THZ(I,KT)=THZ(I,KT)-HGH
CALL LCOUNT(6+IT .LCT,NPG,RECORD(35))
312 IF (IT-1) 2312,1312,1312
1312 WRITE(KOUT,528)KT,RHO(KT),(TT2(I,KT),TCP(I,KT),TKP(I,KT),THZ(I,KT)
1,TEP(I,KT),I=1,IT)
2312 CONTINUE
KT=KT+1
IT=0
IF(NC) 356,358,358
356 IF(KT-2) 350,350,411
411 READ (INPUT,681) KT,RHO(KT)
IF (RHO(KT)) 3550,3550,366
3550 WT=1.0
IX=0
3551 IX=IX+1
READ (INPUT,497) NC,TX(IX), F1(IX),F2(IX)
IF (NC) 3552,3551,3552
3552 ILO(11)=1
IHI(11)=IX
IR(11)=1


CALL LCOUNT(9+IX.LCT.NPG.RECORD(35))
IF (IX-1) 6001.6000.6000
6000 WRITE(KOUT.490) (TX(I).F1(I).F2(I).I=1.IX)
6001 CONTINUE
IF (NC) 411.411.359
355 IT=IT+1
READ (INPUT.571) NC.TT2(IT.KT).TCP(IT.KT).TKP(IT.KT)
IF(NC) 354.355.354
354 ILO(KT+2)=1
IHI(KT+2)=ILO(KT+2)+IT-1
IK(KT+2)=ILO(KT+2)
CALL LCOUNT(5+IT .LCT.NPG.RECORD(95))
314 IF (IT-1) 2314.1314.1314
1314 WRITE (KOUT.327) KT.NHD(KT).(TT2(I.KT).TCP(I.KT).TKP(I.KT).I=1.IT)
2314 CONTINUE
IT=0
IF(NC) 411.411.359
C ---------- PYROLYSIS GAS ENTHALPY
359 NT1=0
361 IN=1+NT1


NT1=8+NT1
IF (NT1-IN) 6003,6002,6002
6002 READ (INPUT,575)NC,(TT1(I),I=IN,NT1),(THB(I),I=IN,NT1)
6003 CONTINUE
IF(NC)381,381,382
384 NT1=NT1-1
382 IF(TT1(NT1)) 384,384,385
385 ILO(2)=1
IR(2)=1
IHI(2)=NT1
CALL LCOUNT(3+((NT1+8)/5),LCT,NPG,RECORD(95))
316 WRITE (KOUT,592)
IFN=0
388 IN=IFN+1
IFN=MIN0(NT1,IFN+5)
IF (IFN-IN) 6005,6004,6004
6004 WRITE (KOUT,591)(TT1(I),I=IN,IFN)
WRITE (KOUT,593)(THB(I),I=IN,IFN)
6005 CONTINUE
IF(NT1-IFN) 387,387,388
387 K=1


IF(TNRY(1)) 2004.2004.2005
DO 2002 I=1.19
GO TO 2002
2002 CONTINUE
2011 K=K+1
GO TO 2003
ILO(12)=1
IR(12)=1


NLO(K)=KHI(K)+1
KHIK=KHI(K)
NLOK=NLO(K)
NHIK=NHI(K)
DO 2007 I=1.KHIK
2007 TTS(I,K,2)=TTS(I,K,1)
IF(NHIK-NLOK) 2010,2009,2009
2009 DO 2008 I=NLOK.NHIK
TLMC(I,K,1)=ALOG(AMAX1(TLMC(I,K,1),.00001))
2008 TLMC(I,K,2)=TLMC(I,K,1)
2010 CONTINUE
600 FORMAT(20F4.0)
VFZ=1.0
IF(BP0.GT.0.) VFZ=BP0
RETURN
END

g. Subroutine LOOK (II,XL,X,A,B,C,E,Y,D,IDN) - B33A

(1) Function

Table look-up and linear interpolation routine for CMA.

II = table identification number

XL = value of independent variable for which dependent variables are to be evaluated

X = name of independent variable

A, B, C, E = names of dependent variables (if less than four, unneeded places must be filled with dummy place holders

Y( ) = names of output values of dependent variables (arrayed in order of call from left to right) at XL

D( ) = names of output values of derivatives of dependent variables Y( )

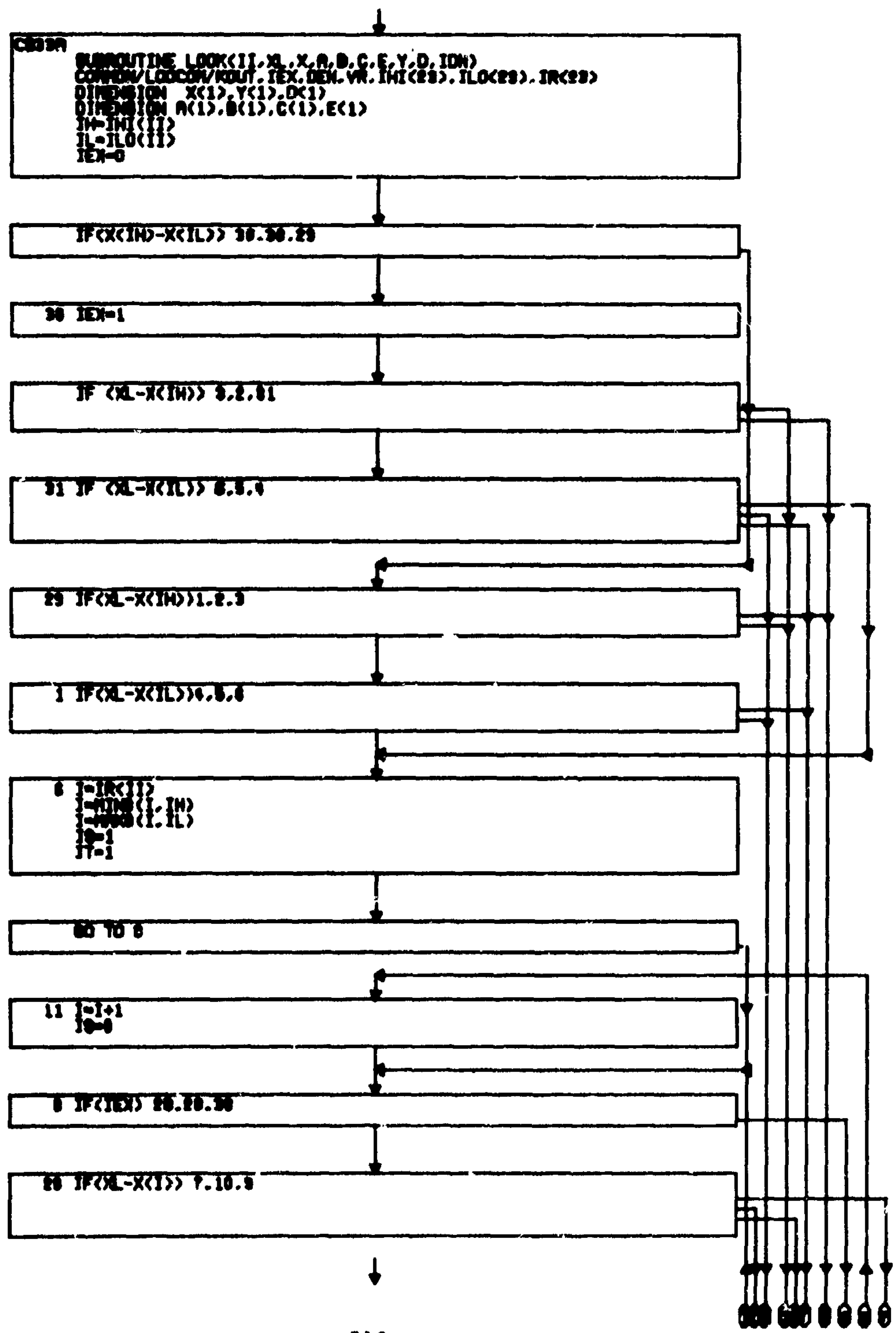
IDN = number of dependent variables in list

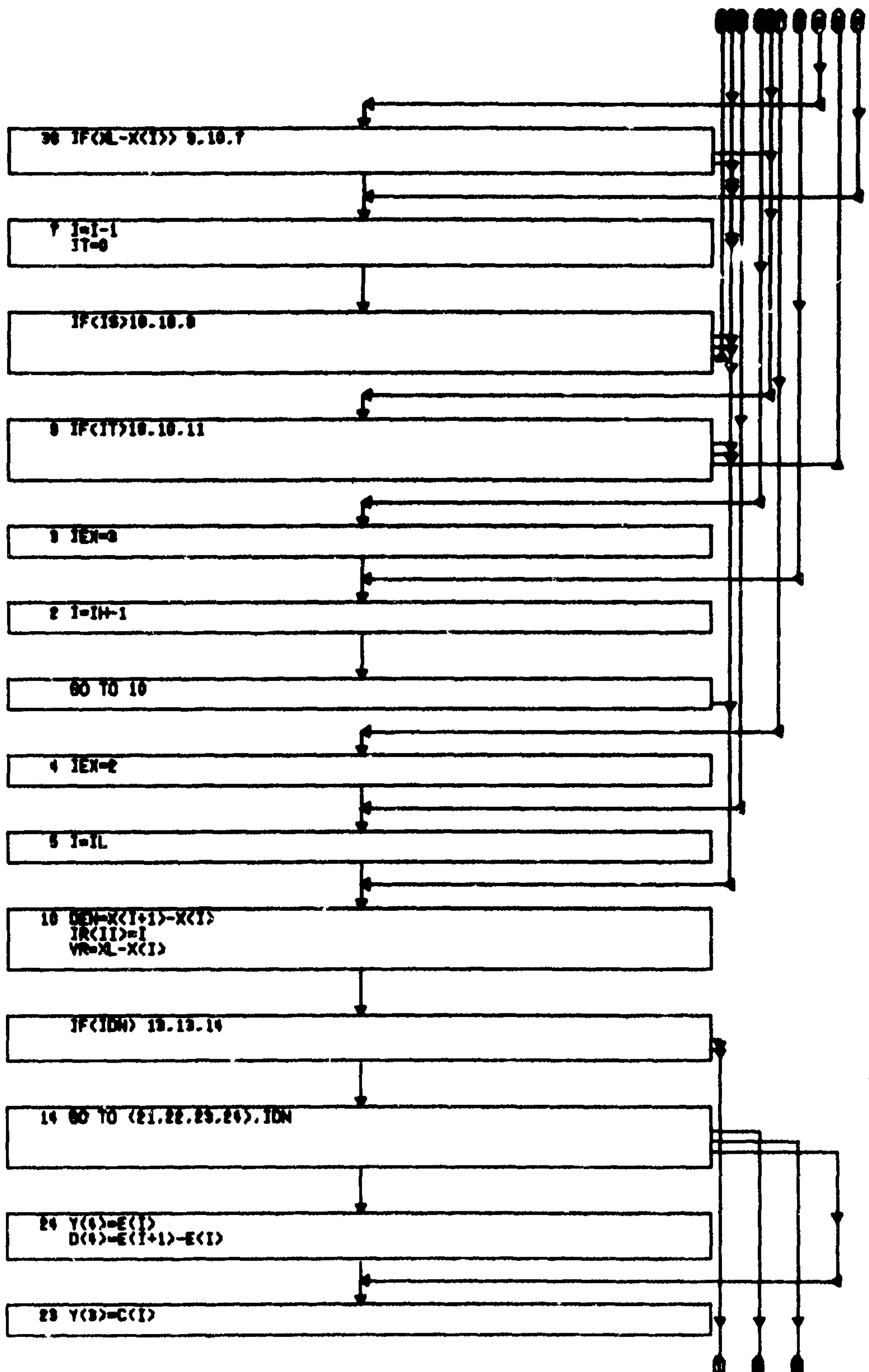
Called by CABLE, CMA, SBCPKG.

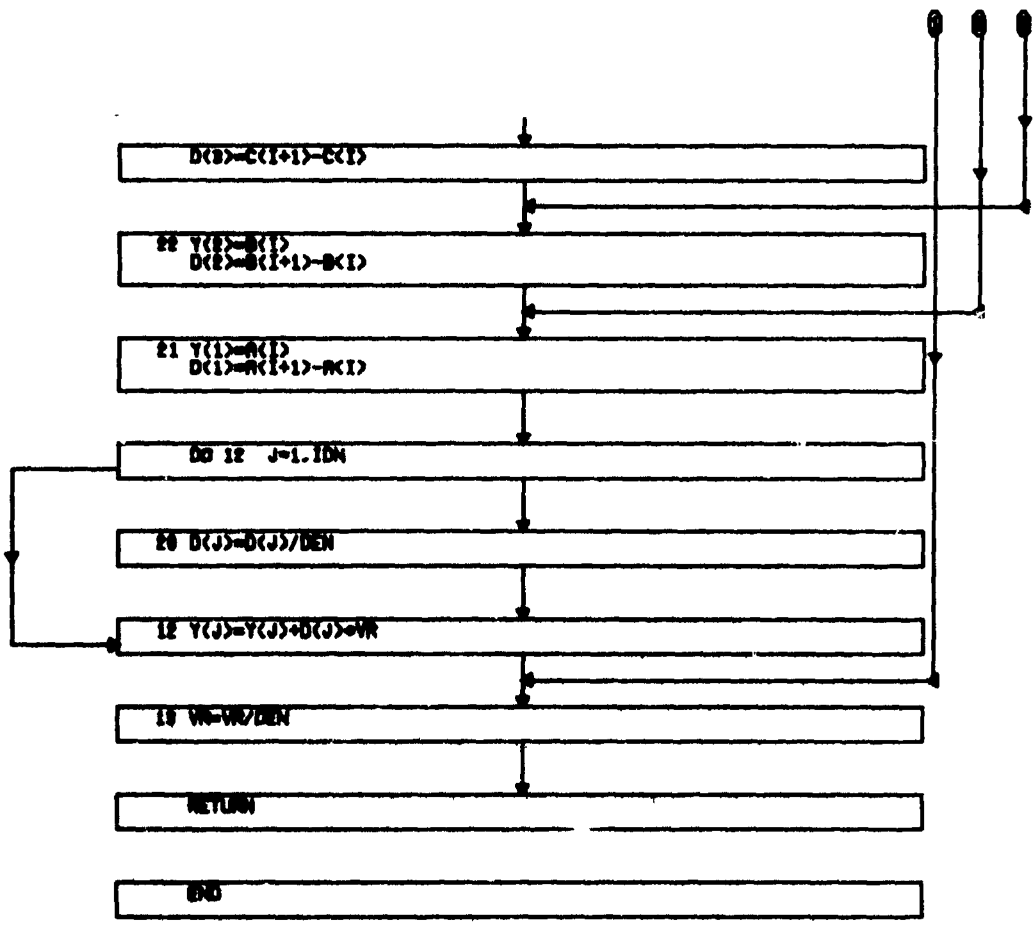
(2) **Listing**

```
      CB33A
      SUBROUTINE LOOK(II,XL,X,A,B,C,E,Y,D,IDN)
      COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)
      DIMENSION  X(1),Y(1),D(1)
      DIMENSION A(1),B(1),C(1),E(1)
      IH=IHI(II)
      IL=ILO(II)
      IEX=0
      IF(X(IH)-X(IL)) 30,30,29
   30 IEX=1
      IF (XL-X(IH)) 3,2,31
   31 IF (XL-X(IL)) 6,5,4
   29 IF(XL-X(IH))1,2,3
    1 IF(XL-X(IL))4,5,6
    6 I=IR(II)
      I=MIN0(I,IH)
      I=MAX0(I,IL)
      IS=1
      IT=1
      GO TO 8
   11 I=I+1
      IS=0
    8 IF(IEX) 28,28,38
   28 IF(XL-X(I)) 7,10,9
   38 IF(XL-X(I)) 9,10,7
    7 I=I-1
      IT=0
      IF(IS)10,10,8
    9 IF(IT)10,10,11
    3 IEX=3
    2 I=IH-1
      GO TO 10
    4 IEX=2
    5 I=IL
   10 DEN=X(I+1)-X(I)
      IR(II)=I
      VR=XL-X(I)
      IF(IDN) 13,13,14
   14 GO TO (21,22,23,24),IDN
   24 Y(4)=E(I)
      D(4)=E(I+1)-E(I)
   23 Y(3)=C(I)
      D(3)=C(I+1)-C(I)
   22 Y(2)=B(I)
      D(2)=B(I+1)-B(I)
   21 Y(1)=A(I)
      D(1)=A(I+1)-A(I)
      DO 12  J=1,IDN
   20 D(J)=D(J)/DEN
   12 Y(J)=Y(J)+D(J)*VR
   13 VR=VR/DEN
      RETURN
      END
```

(3) Flow Chart


C0039
SUBROUTINE LOOK(II,XL,X,A,B,C,E,Y,D,IDN)
COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)
DIMENSION X(1),Y(1),D(1)
DIMENSION A(1),B(1),C(1),E(1)
IH=IHI(II)
IL=ILO(II)
IEX=0
IF(X(IH)-X(IL)) 30,30,29
30 IEX=1
IF (XL-X(IH)) 5,2,31
31 IF (XL-X(IL)) 6,5,4
29 IF(XL-X(IH))1,2,3
1 IF(XL-X(IL))4,5,6
6 I=IR(II)
I=MIN0(I,IH)
I=MAX0(I,IL)
IG=1
IT=1
GO TO 8
11 I=I+1
IG=0
8 IF(IEX) 20,20,30
20 IF(XL-X(I)) 7,10,9


30 IF(XL-X(I)) 9.10.7
7 I=I-1
IT=0
IF(IS)10.10.8
8 IF(IT)10.10.11
3 IEX=0
2 I=IH-1
GO TO 10
4 IEX=2
5 I=IL
10 DEN=X(I+1)-X(I)
IR(II)=I
VR=XL-X(I)
IF(IDN) 13.13.14
14 GO TO (21.22.23.24).IDN
24 Y(4)=E(I)
D(4)=E(I+1)-E(I)
23 Y(3)=C(I)


D(3)=C(I+1)-C(I)
22 Y(2)=B(I)
D(2)=B(I+1)-B(I)
21 Y(1)=A(I)
D(1)=A(I+1)-A(I)
DO 12 J=1,IDN
20 D(J)=D(J)/DEN
12 Y(J)=Y(J)+D(J)*VR
10 VR=VR/DEN
RETURN
END

h. Subroutine COMP (X,Y,VOID, IFLAG)

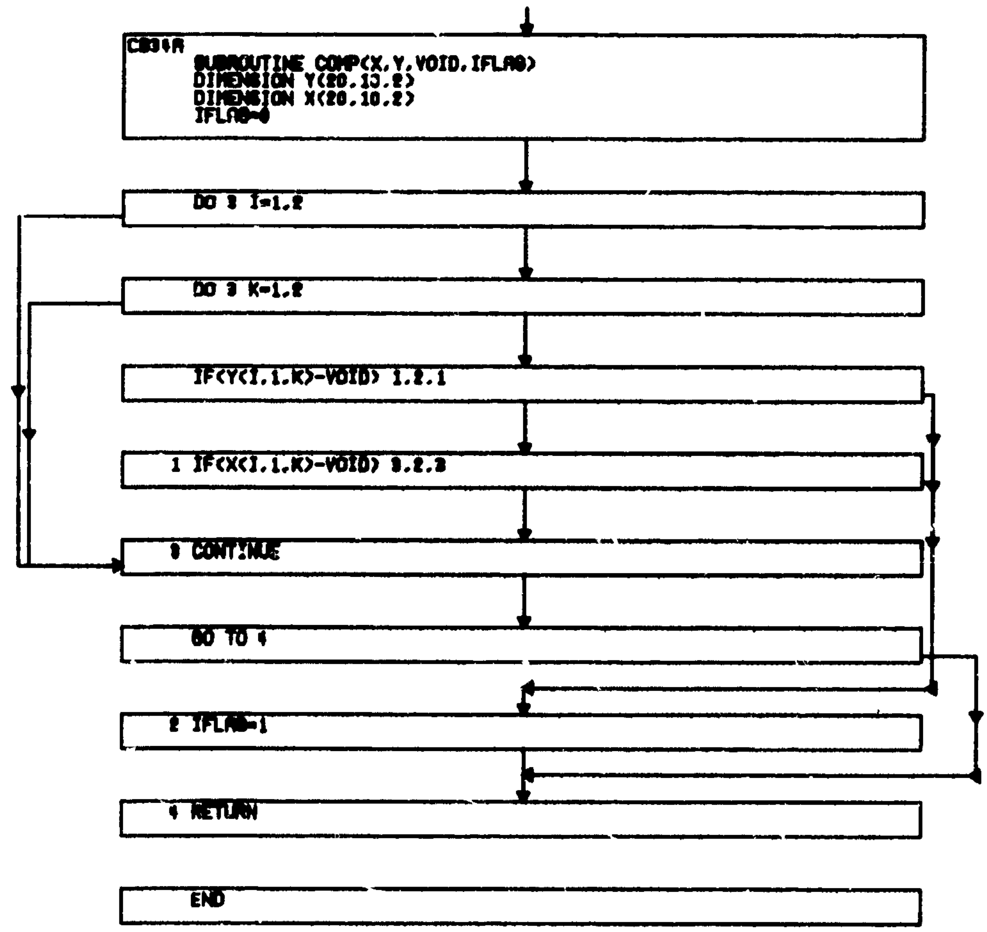
(1) Function

Determines whether the word "VOID" exists at any of the eight corners of the interpolation matrix of BLIMP solutions. Called by SBCPKG.

(2) Listing

```
C834A                                                  B34A 001
      SUBROUTINE COMP(X,Y,VOID,IFLAG)
      DIMENSION Y(20,10,2)                              B34A 003
      DIMENSION X(20,10,2)                              B34A 004
      IFLAG=0                                           B34A 005
      DO 3 I=1,2                                        B34A 007
      DO 3 K=1,2
      IF(Y(I,1,K)-VOID) 1,2,1
    1 IF(X(I,1,K)-VOID) 3,2,3                           B34A 009
    3 CONTINUE                                          B34A 010
      GO TO 4                                           B34A 011
    2 IFLAG=1                                           B34A 012
    4 RETURN                                            B34A 013
      END
```

(3) Flow Chart


C034R
SUBROUTINE COMP(X,Y,VOID,IFLAG)
DIMENSION Y(20,10,2)
DIMENSION X(20,10,2)
IFLAG=0
DO 3 I=1,2
DO 3 K=1,2
IF(Y(I,1,K)-VOID) 1,2,1
1 IF(X(I,1,K)-VOID) 3,2,3
3 CONTINUE
GO TO 4
2 IFLAG=1
4 RETURN
END

i. Subroutine OGLE (N,XAM,PRM,NUMX,X,P,EM) - B36A

(1) Function

Subroutine OGLE looks up an array of values of a single dependent variable corresponding to an array of values of a single independent variable, using a cubic curve fit between any two points of the table. The curve fit employs the values and slopes of the independent variable at the tabular points surrounding the look-up value of the independent variable to determine the four constants of the cubic interpolation function. The necessary slopes are conveniently provided by subroutine SLOPQ. Points off the ends of the table are evaluated with a linear extension of the tabulated values, using the input slopes at the first and last tabular entries. Called by CMA.

N = number of points to be considered

XAM = name of value of independent variable for which look-up is to be performed (if an array, looking starts at XL(1) and proceeds to XL(N))

PRM = name of output interpolated values returned by OGLE

NUMX = number of tabular entries in the table

X = name of tabular independent variable

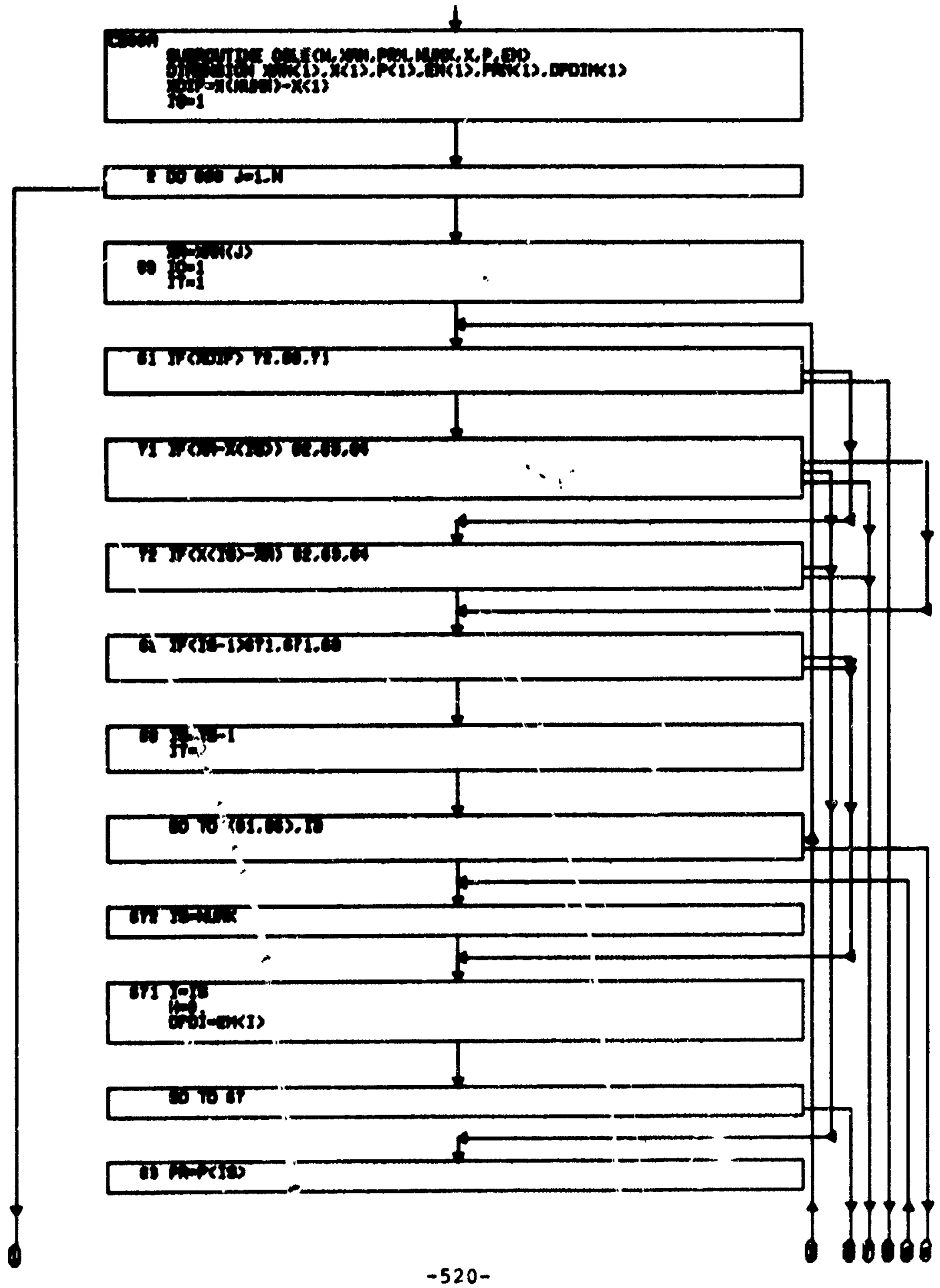
P = name of tabular dependent variable

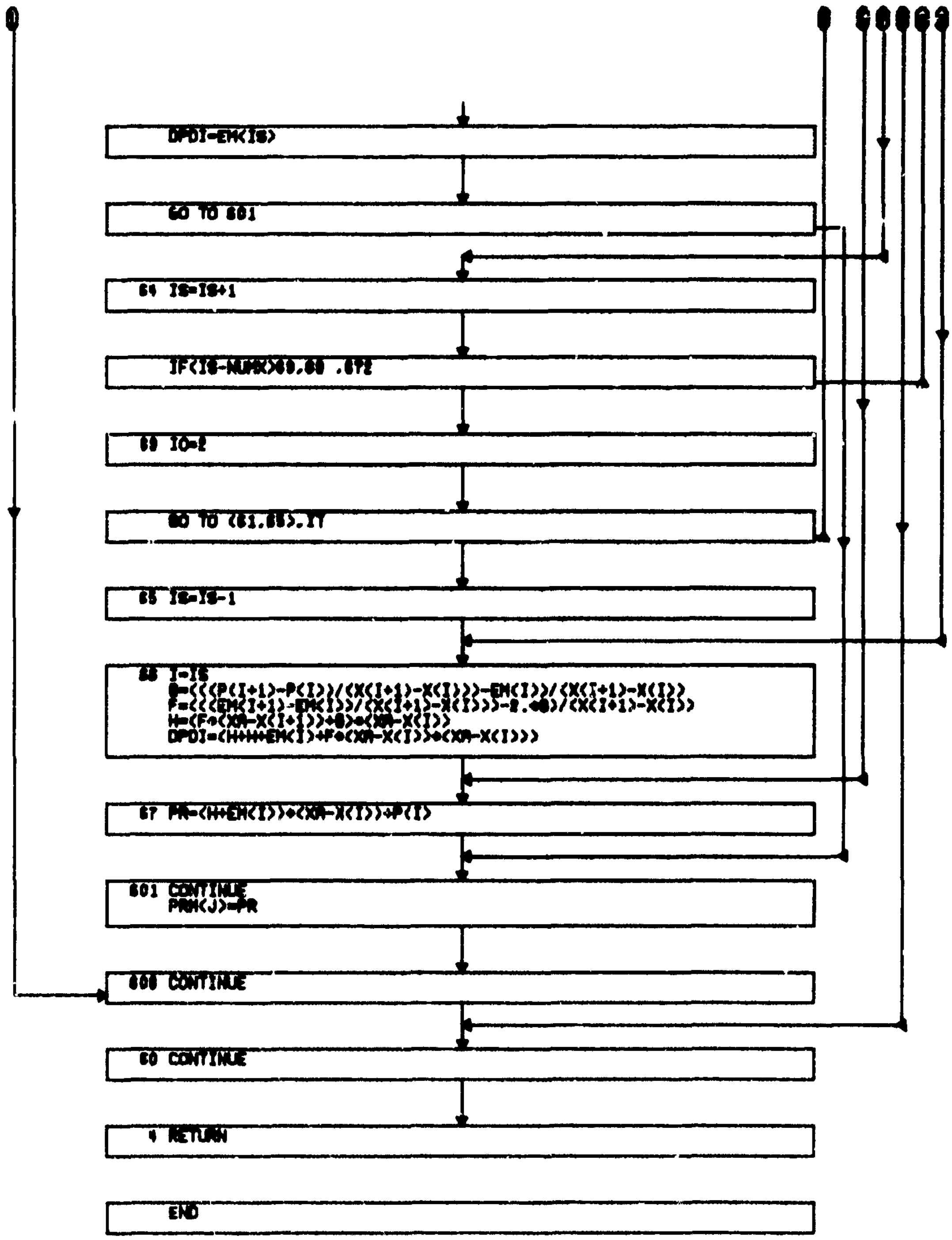
EM = name of slopes to be used.

(2) Listing

```
CB36A
      SUBROUTINE OGLE(N,XAM,PRM,NUMX,X,P,EM)
      DIMENSION XAM(1),X(1),P(1),EM(1),PRM(1),DPDIM(1)
      XDIF=X(NUMX)-X(1)
      IS=1
    2 DO 600 J=1,N
      XA=XAM(J)
   59 IO=1
      IT=1
   61 IF(XDIF) 72,60,71
   71 IF(XA-X(IS)) 62,63,64
   72 IF(X(IS)-XA) 62,63,64
   62 IF(IS-1)671,671,68
   68 IS=IS-1
      IT=2
      GO TO (61,66),IO
  672 IS=NUMX
  671 I=IS
      H=0.
      DPDI=EM(I)
      GO TO 67
   63 PR=P(IS)
      DPDI=EM(IS)
      GO TO 601
   64 IS=IS+1
      IF(IS-NUMX)69,69 ,672
   69 IO=2
      GO TO (61,65),IT
   65 IS=IS-1
   66 I=IS
      G=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))
      F=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*G)/(X(I+1)-X(I))
      H=(F*(XA-X(I+1))+G)*(XA-X(I))
      DPDI=(H+H+EM(I)+F*(XA-X(I))*(XA-X(I)))
   67 PR=(H+EM(I))*(XA-X(I))+P(I)
  601 CONTINUE
      PRM(J)=PR
  600 CONTINUE
   60 CONTINUE
    4 RETURN
      END
```

(3) Flow Chart




DPDI=EM(IS)
GO TO 601
64 IS=IS+1
IF(IS-NUMX)60,60 ,672
60 IO=2
GO TO (61,65),IT
65 IS=IS-1
66 I=IS
G=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))
F=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*G)/(X(I+1)-X(I))
H=(F*(XR-X(I+1))+G)*(XR-X(I))
DPDI=(H+H+EM(I)+F*(XR-X(I))*(XR-X(I)))
67 PR=(H+EM(I))*(XR-X(I))+P(I)
601 CONTINUE
PRM(J)=PR
600 CONTINUE
60 CONTINUE
4 RETURN
END

j. Subroutine LCOUNT (J,LCT,NPG,R) - B37A

(1) Function

Line counting and page numbering routine for output. Called by CMA, INPOUT.

J = number of lines to be output (if written negative, the subroutine will automatically being a new page, otherwise the subroutine begins a new page only if I would lap over onto the next page)

LCT = number of lines left on page (the subroutine keeps track of this quantity if a variable name is entered in the call list)

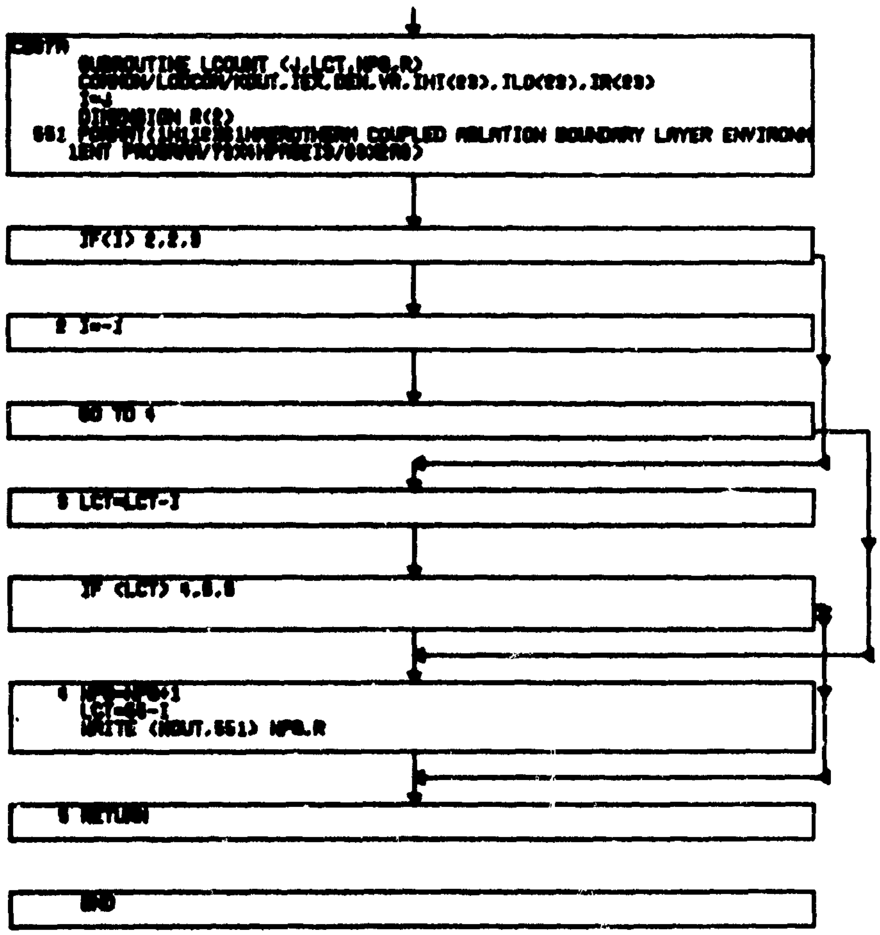
NPG = page number (the subroutine keeps track of this quantity if a variable name is entered in the call list; the quantity NPG must be initialized outside the subroutine)

R( ) = a title in format 2A6 which will be printed on each new page.

(2) **Listing**

```
C837A                                                                   B37A 001
      SUBROUTINE LCOUNT (J,LCT,NPG,R)                                   B37A 002
      COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)              B37A 003
      I=J                                                               B37A 004
      DIMENSION R(2)                                                    B37A 005
  551 FORMAT(1H112X61HAEROTHERM COUPLED ABLATION BOUNDARY LAYER ENVIRONM
     1ENT PROGRAM/73X4HPAGEI3/68X2A6)
      IF(I) 2,2,3                                                       B37A 008
    2 I=-I                                                              B37A 009
      GO TO 4                                                           B37A 010
    3 LCT=LCT-I                                                         B37A 011
      IF (LCT) 4,5,5                                                    B37A 012
    4 NPG=NPG+1                                                         B37A 013
      LCT=55-I                                                          B37A 014
      WRITE (KOUT,551) NPG,R                                            B37A 015
    5 RETURN                                                            B37A 016
      END                                                               B37A 017
```

(3) Flow Chart


SUBROUTINE LCOUNT (J,LCT,NPG,R)
IF(I) 2,2,3
2 I=-I
GO TO 4
3 LCT=LCT-I
IF (LCT) 4,5,5
4 NPG=NPG+1
LCT=60-I
WRITE (NOUT,551) NPG,R
5 RETURN
END

k. Subroutine SBCPKG - B38A

(1) Function

This routine performs the surface energy balance and implements the surface boundary conditions. Called by CMA. Calls LOOK, COMP.

(2) Listing

```
      CB38A
      SUBROUTINE SBCPKG
      COMMON/CAMCOM/TLMC(20,10,2),TMG(20),TTS(20,10,2),TCHEM(20,10,2),
     1NLO(20),NHI(20),KHI(20),JCMA,IMG,IMC,NMG,
     2TCH(2),TPR(2),TRAD(2),IAB
     3,TT2(20,2),THZ(20,2),TT1(30),THG(30),DH12(2),TA(39),DELHG,I1,I2,CH
     4,CMD,BPHMG,KCM(10)
      EQUIVALENCE (NCLASS,JCMA)
      COMMON/LOOCOM/KOUT,IEX,DEN,VR,IHI(23),ILO(23),IR(23)
      COMMON/CMACOM/TEP(20,2), TCP(20, 2),TKP(20, 2)
     3,RHO(2),MATL(38),DEL(39),SO(20),H(38),RC(38),RA(38),RECORD(36),
     4AREA(38),EMA(38),RAV(38),
     5ROA(152),ROB(152),ROC(152),
     6    TPI(30),VFZ,CMH,NPR,
     7LCT,NPG,II,NBM,NUMN,NL,       DELM,RFT,RHORA,RHORB,RHORC,TRA
     8CA,TRACB,TRACC,RHOOA,RHOOB,RHOOC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,
     9TRACM,PET,PETE,RSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WT
      COMMON/CMACOM/EPSW,TRES,
     1TMWT,GAMA,OMG,NO,FJFH,FJFS,JF,JFHP,JFH,INPUT,     DTHIN,BRP,HCONV,
     2INCH,DTHB,NN,NI,NOI,CHCRI,PYCRI,NCON,     NR,TX(30),F1(30),F2(30)
      COMMON/SBCP/BF,CMMA,CMMI,DERR,DMIV,EMIV,ERFX,ERRC,ERR,ERRS,I3,I4,
     1VRM,VRP, IPR,IRA,IRB,IRC,IRD,ITL,PHI,QQ,TABC,TEMP,TSMA,TSMI,TSSQ
      COMMON/SBCP/ TNXT,   DNCP(3),CPE(3),TO(20),VITER(51),EITER(51)
      COMMON/SBCP/ Y2(16),D2(16),Y3(8),D3(8),Y1(2),D1(2)
      COMMON/SBCP/ CPC( 50),CPV( 50),CP( 50),HP ( 50),HC( 50),CN( 50),
     1RAT( 50),ROT( 50),RO( 50),X( 50),RON( 50),DMDG( 50),RR ( 50),
     2CNC( 50),A( 50),B( 50),C( 50),D( 50),EMO( 50),CNO( 50)
      COMMON/SBCP/BR,   CHZ,    CMPL,    DEDT,DEDTT,DSDTB,DTH,GSMS,HW,
     1HE,    ITS,PRES,QCHEM,QCHEMT QCOND,QCONDT,QCONV,QCONVT,QRA,QRP,
     2QRPT,RAD,RADT,RSU,SIG,   TSAVE,VF,XP1,ASU
      COMMON/MISC/      BPRM,CMT,COLD,CP1,CPGAS,CPNL,CZ,DCDT,DECOM,
     1DECOMT,DELCR,DELR,DENOLD,DIDT,DNS,DPDT,DRLCP,DRLC,DRLP,DRL,DROAC,
     2DROAT,DROBC,DROBT,DROCC,DROCT,DRODTD,DSDT,DSI,DS,DSS,DTA,DTHC,DTHS
     3,DTS,DVB,DZ,EGO,EZ,FACT1,FACT2,FA,FB,FC,FJF,FK,FZ,GSEGR,GSM,GSMT,
     4GZ,H1,HAPHB,HBAR,HGAS,HRES,IE,IMIN,I,IS,ISV,ITER,J1,J,KK,K,KT,L,
     5NDR,NLI,NLM,N,NZ,O,PGPU,PGPUT,POLO,POW,QLOSS,QLOSST,RD,RO1,ROOZ,SA
     6,SOEGR,TAS,TB,TERM1,TERM2,TERM3,THDS,TH,THPRT,TN,TOP1,TOP2,TOP3,T,
     7TT,VOL,X1
      EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)
      DATA VOID/4HVOID/
  529 FORMAT(17H  ITERATION STOP  )
  582 FORMAT(1P12E10.3)
      IF(JCMA-2) 771,771,770
  770 IF(JCMA-4) 2513,744,753
  771 CONTINUE
      XP1=X(1)
      VF=VFZ
      ITL=10
      ITS=1
      VRP=(TH-TPR(1))/(TPR(2)-TPR(1))
      TNXT=AMAX1(TPR(2),TPR(1))
      CH = TCH(1)+VRP*(TCH(2)-TCH(1))
      QRA=TRAD(1)+VRP*(TRAD(2)-TRAD(1))
      CHZ=CH
      IPR=1
      ERFX=D(1)
      CALL LOOK(12,GSMS/CH,TMG,0,0,0,0,Y2,D2,0)
      IMG=IR(12)
```

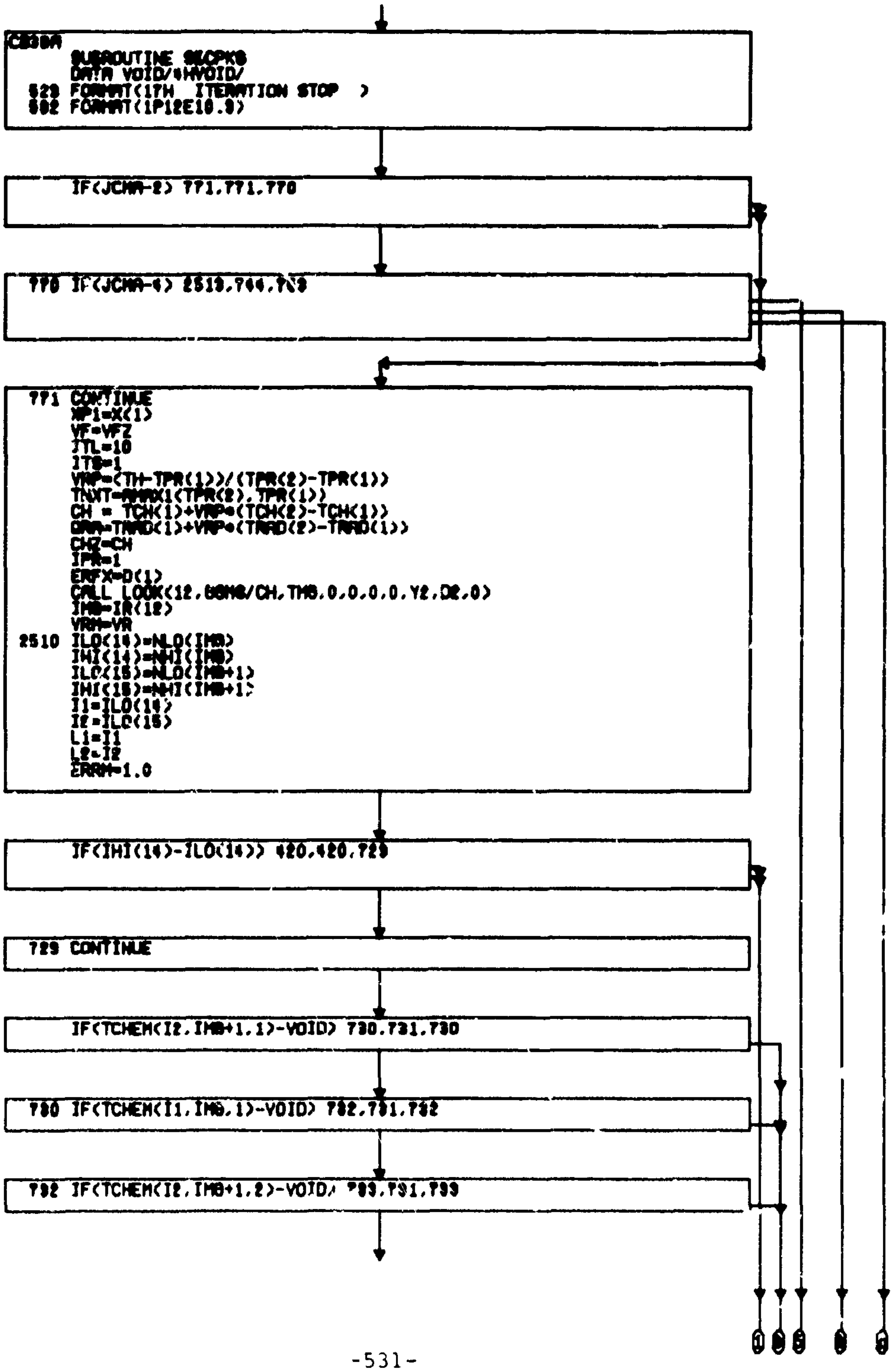
```
           VRM=VR                                                       B38A 058
      2510 ILO(14)=NLO(IMG)                                             B38A 059
           IHI(14)=NHI(IMG)                                             B38A 060
           ILO(15)=NLO(IMG+1)                                           B38A 061
           IHI(15)=NHI(IMG+1)                                           B38A 062
           I1=ILO(14)                                                   B38A 063
           I2=ILO(15)                                                   B38A 064
           L1=I1
           L2=I2
           ERRM=1.0
           IF(IHI(14)-ILO(14)) 420,420,729
       729 CONTINUE
           IF(TCHEM(I2,IMG+1,1)-VOID) 730,731,730                       B38A 065
       730 IF(TCHEM(I1,IMG,1)-VOID) 732,731,732                         B38A 066
       732 IF(TCHEM(I2,IMG+1,2)-VOID) 733,731,733                       B38A 067
       733 IF(TCHEM(I1,IMG,2)-VOID) 2513,731,2513                       B38A 068
       731 JCMA=3                                                       B38A 069
           RETURN                                                       B38A 070
      2513 TABC=TTS(I1,IMG,1)+VRM*(TTS(I2,IMG+1,1)-TTS(I1,IMG,1))       B38A 071
      2515 TABC=TABC+VRP*(TTS(I1,IMG,2)+VRM*(TTS(I2,IMG+1,2)-TTS(I1,IMG+1,2))B38A 072
          1-TABC)                                                       B38A 073
      2503 IF(TSAVE-TABC+.0001) 420,420,421
     C     ----------  ABLATING SURFACE                                 B38A 075
       421 IF(IAB) 422,422,423                                          B38A 076
       422 CMDL=TLMC(I1,IMG,1)-VRM*(TLMC(I1,IMG,1)-TLMC(I2,IMG+1,1))     B38A 077
           CMD=EXP(CMDL)*CH                                             B38A 078
           IAB=1                                                        B38A 079
       423 CALL LOOK(14,CMDL,TLMC(1,IMG,1),0,0,0,0,0,0,0)               B38A 080
           IRA=IR(14)                                                   B38A 081
           I1=IRA                                                       B38A 082
           CALL LOOK(15,CMDL,TLMC(1,IMG+1,1),0,0,0,0,0,0,0)             B38A 083
           IRB=IR(15)                                                   B38A 084
           I2=IRB                                                       B38A 085
           CALL COMP (TCHEM(I1,IMG,1),TCHEM(I2,IMG+1,1),VOID,IFLAG)
           IF(IFLAG-1) 740,741,740                                      B38A 087
       741 JCMA=4                                                       B38A 088
           RETURN                                                       B38A 089
       740 CONTINUE                                                     B38A 090
       744 CALL LOOK(14,CMDL,TLMC(1,IMG,1),TTS(1,IMG,1),TCHEM(1,IMG,1),0,0,  B38A 091
          1Y2(1),Y2(3),2)                                               B38A 092
           CALL LOOK(15,CMDL,TLMC(1,IMG+1,1),TTS(1,IMG+1,1),TCHEM(1,IMG+1,1),B38A 093
          10,0,Y2(5),Y2(7),2)                                           B38A 094
           CALL LOOK(14,CMDL,TLMC(1,IMG,2),TTS(1,IMG,2),TCHEM(1,IMG,2),0,0,  B38A 095
          1Y2(9),Y2(11),2)                                              B38A 096
           CALL LOOK(15,CMDL,TLMC(1,IMG+1,2),TTS(1,IMG+1,2),TCHEM(1,IMG+1,2),B38A 097
          10,0,Y2(13),Y2(15),2)                                         B38A 098
           IIX=IEX-2
           DO 4232 I=1,8                                                B38A 099
      4232 Y2(I)=Y2(I)+VRP*(Y2(I+8)-Y2(I))                              B38A 100
      4233 DO 426 I=1,4                                                 B38A 101
       426 Y2(I)=Y2(I)+ (Y2(I+4)-Y2(I))*VRM                             B38A 102
           IF(Y2(1)) 4260,4260,4261                                     B38A 103
      4260 ITL=ITS                                                      B38A 104
           GO TO 4356                                                   B38A 105
      4261 CONTINUE                                                     B38A 106
           CALL LOOK(4,Y2(1),TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)       B38A 107
           IF(MATL(1)-2) 428,427,428                                    B38A 108
       428 CALL LOOK(3,Y2(1),TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)           B38A 109
           EMIV=EMIV+XP1*(Y3(1)-EMIV)
           DMIV=DMIV+XP1*(D3(1)-DMIV)
```

```
  427 TSSQ=Y2(1)*Y2(1)                                                  B38A 112
      TS=Y2(1)                                                          B38A 113
      RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         B38A 114
  436 ERR=CH*Y2(2)+EMIV*QRA-RAD-B(1)*TS+ERFX                            B38A 115
      ERRM=AMAX1(ABS(CH*Y2(2)),ABS(EMIV*QRA),ABS(RAD),ABS(B(1)*TS),
     1  ABS(ERFX))
      DERR=CH*Y2(4)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))*Y2(3)          B38A 116
      IF(DERR) 4365,4365,4362
 4362 IF(IIX) 4365,4368,4365
 4368 ITL=ITS
      GO TO 4356
 4365 CONTINUE
      ERRC=ERR/DERR                                                     B38A 117
      VITER(ITS)=CMDL                                                   B38A 118
      EITER(ITS)=ERR                                                    B38A 119
      CMDL=CMDL-ERRC                                                    B38A 120
      CMMI=-1.E+30                                                      B38A 121
      CMMA=+1.E+30                                                      B38A 122
      IF(ILO(14)-IRA) 4361,4363,4363                                    B38A 123
 4361 IF(ILO(15)-IRB) 4270,4363,4363                                    B38A 124
 4270 CMMI=AMAX1(CMMI,TLMC(IRA,IMG,IPR)+TLMC(IRA-1,IMG,IPR),TLMC(IRB,IMGB38A 125
     1+1,IPR)+TLMC(IRB-1,IMG+1,IPR))/2.                                 B38A 126
      CMDL=AMAX1(CMDL,CMMI)                                             B38A 127
 4363 IF(IHI(14)-IRA-1) 4369,4369,4364
 4364 IF(IHI(15)-IRB-1) 4369,4369,4275
 4369 IF(ITS-ITL) 4366,4366,4360
 4360 IF(ERRS) 420,4367,4367
 4275 CMMA=AMIN1(CMMA,TLMC(IRA+1,IMG,IPR)+TLMC(IRA+2,IMG,IPR),TLMC(IRB+1B38A 130
     1,IMG+1,IPR)+TLMC(IRB+2,IMG+1,IPR))/2.                             B38A 131
      CMDL=AMIN1(CMDL,CMMA)                                             B38A 132
      IF(ITS-ITL-1) 4366,4351,4352                                      B38A 133
 4351 ERRS=ERR                                                          B38A 134
      CMDL=CMMA                                                         B38A 135
      GO TO 4278
 4352 IF(ERR*ERRS) 4354,4367,4353                                       B38A 137
 4353 CMDL=CMMA                                                         B38A 138
      GO TO 4278
 4354 ITL=55                                                            B38A 140
      IF(ERRC) 4355,4367,4367                                           B38A 141
 4355 CMDL=CMMI                                                         B38A 142
      GO TO 4278
 4366 IF(ITS-ITL) 4367,4356,4367                                        B38A 144
 4356 CMDL=AMIN1(TLMC(L1,IMG,IPR),TLMC(L2,IMG+1,IPR))
 4279 CMDL=AMIN1(CMDL,TLMC(L1,IMG,IPR+1),TLMC(L2,IMG+1,IPR+1))
 4278 ERR=1.E+20
 4367 CMD=EXP(CMDL)*CH                                                  B38A 147
      IF(ITS-50) 440,440,998                                            B38A 148
  440 ITS=ITS+1                                                         B38A 149
      IF(ABS(ERR/ERRM)-.01) 4372,4372,423
C     ----------  NON-ABLATING SURFACE                                  B38A 151
  420 TS=TSAVE                                                          B38A 152
      IAB=0                                                             B38A 153
      CMD=0.0                                                           B38A 154
 4302 ILO(18)=1                                                         B38A 155
      IHI(18)=KHI(IMG)                                                  B38A 156
      ILO(19)=1                                                         B38A 157
      IHI(19)=KHI(IMG+1)                                                B38A 158
  430 CONTINUE                                                          B38A 159
      CALL LOOK(18,TS,TTS(1,IMG,1),0,0,0,0,0,0,0)                       B38A 160
      CALL LOOK(19,TS,TTS(1,IMG+1,1),0,0,0,0,0,0,0)                     B38A 161
```

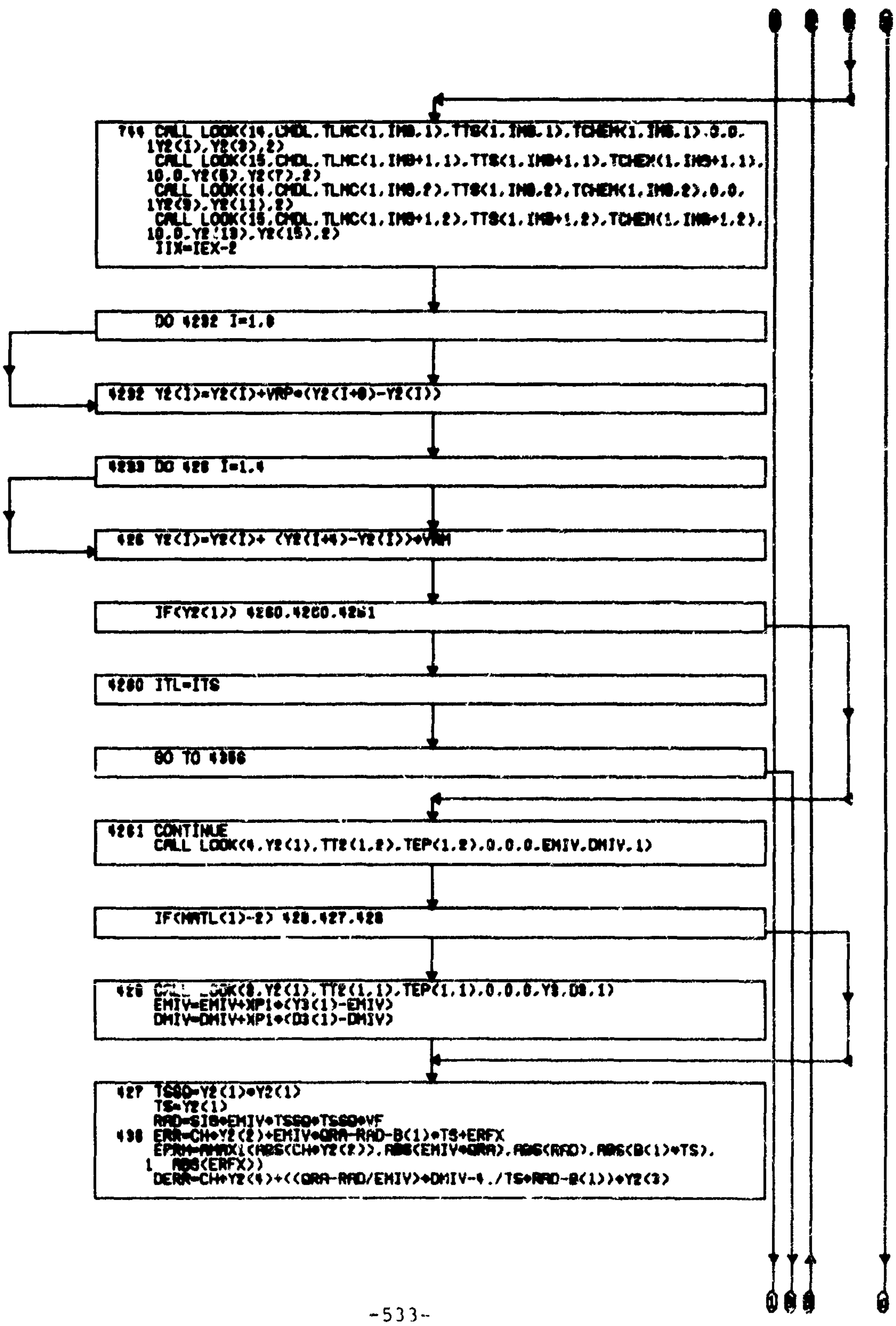
```
      IRA=IR(18)                                                        B38A 162
      I1=IRA                                                            B38A 163
      IRB=IR(19)                                                        B38A 164
      I2=IRB                                                            B38A 165
      CALL COMP (TCHEM(I1,IMG,1),TCHEM(I2,IMG+1,1),VOID,IFLAG)
      IF(IFLAG-1) 742,743,742                                           B38A 167
  743 JCMA=5                                                            B38A 168
      RETURN                                                            B38A 169
  742 CONTINUE                                                          B38A 170
  753 CALL LOOK(18,TS,TTS(1,IMG  ,1),TCHEM(1,IMG  ,1),TLMC(1,IMG  ,1),
     1 0,0,Y2(1),Y2(3),2)
      CALL LOOK(18,TS,TTS(1,IMG+1,1),TCHEM(1,IMG+1,1),TLMC(1,IMG+1,1),
     1 0,0,Y2(5),Y2(7),2)
      CALL LOOK(18,TS,TTS(1,IMG  ,2),TCHEM(1,IMG  ,2),TLMC(1,IMG  ,2),
     1 0,0,Y2(9),Y2(11),2)
      CALL LOOK(18,TS,TTS(1,IMG+1,2),TCHEM(1,IMG+1,2),TLMC(1,IMG+1,2),
     1 0,0,Y2(13),Y2(15),2)
      DO 4321 I=1,8
 4321 Y2(I)=Y2(I)+VRP*(Y2(I+8)-Y2(I))
 4322 DO 4323 I=1,4
 4323 Y2(I)=Y2(I)+VRM*(Y2(I+4)-Y2(I))
  433 CALL LOOK (4,TS,TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)              B38A 181
      IF(MATL(1)-2) 434,442,434                                         B38A 182
  434 CALL LOOK (3,TS,TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)                  B38A 183
      EMIV=EMIV+XP1*(Y3(1)-EMIV)
      DMIV=DMIV+XP1*(D3(1)-DMIV)
  442 TSSQ=TS*TS                                                        B38A 186
 4422 RAD=SIG*EMIV*TSSQ*TSSQ*VF                                         B38A 187
  439 ERR=CH*Y2(1)+EMIV*GRA-RAD-B(1)*TS+ERFX                            B38A 188
      ERRM=AMAX1(ABS(CH*Y2(1)),ABS(EMIV*GRA),ABS(RAD),ABS(B(1)*TS),
     1  ABS(ERFX))
      DERR=CH*Y2(3)+((GRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))
      ERRC=ERR/DERR                                                     B38A 190
      VITER(ITS)=TS                                                     B38A 191
      EITER(ITS)=ERR                                                    B38A 192
      TS=TS-ERRC                                                        B38A 193
 4391 TSMI=-1.E+30                                                      B38A 194
      TSMA=+1.E+30                                                      B38A 195
      IF(ILO(18)-IRA) 4500,4501,4501                                    B38A 196
 4500 IF(ILO(19)-IRB) 4503,4501,4501                                    B38A 197
 4503 TSMI=AMAX1(TSMI,TTS(IRB,IMG+1,IPR)+TTS(IRB-1,IMG+1,IPR),          B38A 198
     1TTS(IRA,IMG,IPR)+TTS(IRA-1,IMG,IPR))/2.                           B38A 199
      TS=AMAX1(TS,TSMI)                                                 B38A 200
 4501 IF(IHI(18)-IRA-1) 4507,4507,4508                                  B38A 201
 4508 IF(IHI(19)-IRB-1) 4507,4507,4510                                  B38A 202
 4510 TSMA=AMIN1(TSMA,TTS(IRB+1,IMG+1,IPR)+TTS(IRB+2,IMG+1,IPR),        B38A 203
     1TTS(IRA+1,IMG,IPR)+TTS(IRA+2,IMG,IPR))/2.                         B38A 204
      TS=AMIN1(TS,TSMA)                                                 B38A 205
 4507 CONTINUE                                                          B38A 206
      IF(ITS-50) 441,441,998                                            B38A 207
  441 ITS=ITS+1                                                         B38A 208
      IF(ABS(ERR/ERRM)-.01) 4390,4390,430
  998 WRITE (KOUT,529)                                                  B38A 210
      WRITE(KOUT,582)(VITER(I),EITER(I),I=1,51)                         B38A 211
      WRITE(KOUT,582) TH,DTH,VRM,ERFX,TABC,EMIV,DMIV,RAD,B(1),CH,PHI,   B38A 212
     1 D(1),HE,XP1,GRA,Y2(1),Y2(2),Y2(3),Y2(4)                          B38A 213
      TH=THFIN                                                          B38A 214
      JCMA=0                                                            B38A 215
      RETURN                                                            B38A 216
C     ----------  POST ITERATION                                        B38A 217
```

```
 4390 CONTINUE
      IF(IAB) 4371,4371,4372
 4371 CMD=EXP(Y2(2))*CH
      Y2(2)=Y2(1)
 4372 QCONV=CH*Y2(2)
      IF(KCM(4)) 4376,4375,4376
 4376 WRITE(KOUT,582) (VITER(I),EITER(I), I=1,ITS)
      WRITE(KOUT,582) TH,DTH,VRM,ERRX,  QC,EMIV,DMIV,RAD,B(1),CH,PHI,
     1 D(1),HE,XP1,QRA,Y2,DERR,VRP
 4375 CONTINUE
      QCHEM=0.
      DSDTB=CMD/RHO(2)
 1437 RR(1)=RON(1)
      BR=CH/CHZ
      QRP=EMIV*QRA
      QCOND=-D(1)+B(1)*TA(1)
      QCONVT=QCONVT+QCONV*DTH/AREA(1)*ASU
      QCHEMT=QCHEMT+QCHEM*DTH/AREA(1)*ASU
      QCONDT=QCONDT+QCOND*DTH/AREA(1)*ASU
      QRPT=QRPT+QRP*DTH/AREA(1)*ASU
      RADT=RADT+RAD*DTH/AREA(1)*ASU
C
      DEDT=RON(1)*CP(1)*(TS-TSAVE)*DEL(1)/DTH
      DO 95 I=2,NL
      RR(I) = RON(I)
      TEMP =(D(I  )-A(I  )*TA(I-1))/B(I  )
      DEDT=DEDT+RON(I)*CP(I)*(TEMP-TA(I))*DEL(I)*RR(I)/DTH
   95 TA(I)=TEMP
      IF (NUMN-NBM) 97,96,96
   96 K=NL
      TA(NBM-1) = TA(NL)
      DO 98 I = NBM,NUMN
      K = K+1
   98 TA(I) = (D(K)-A(K)*TA(I-1))/B(K)
   97 DEDTT=DEDTT+DEDT*DTH/AREA(1)*ASU
      JCMA=1
      RETURN
      END
```

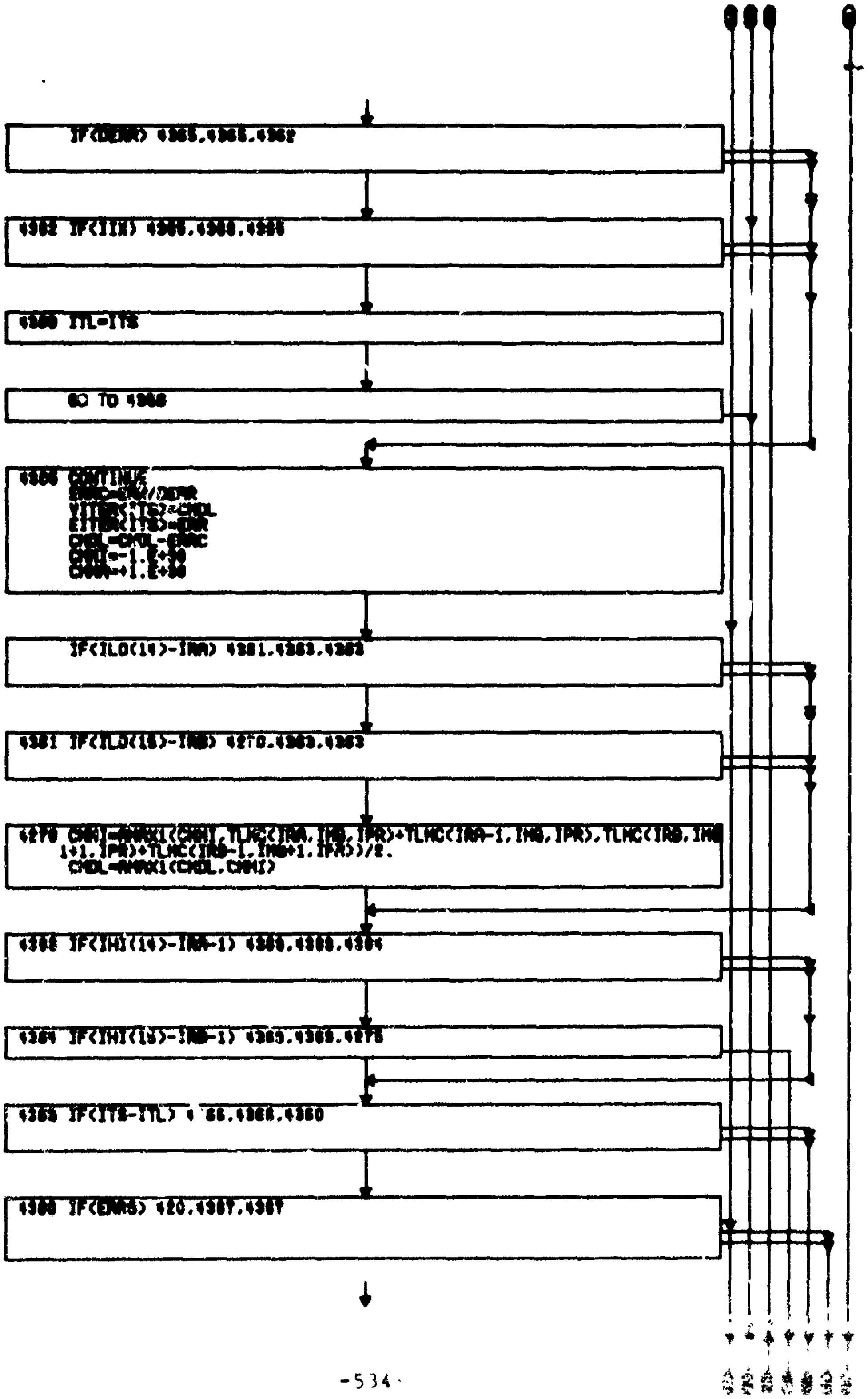
(3) Flow Chart

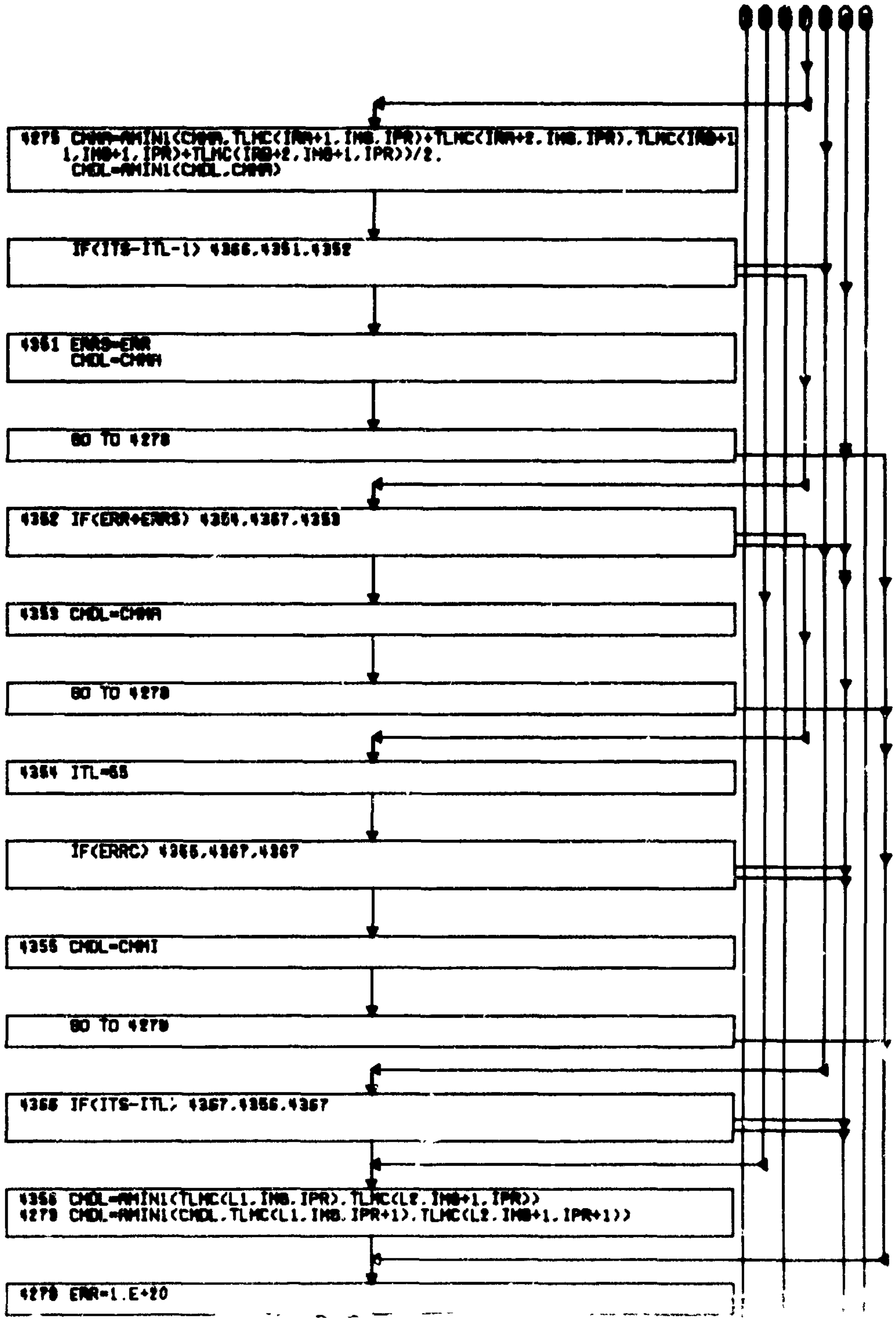

CS30A
SUBROUTINE SECPKS
DATA VOID/4HVOID/
523 FORMAT(17H ITERATION STOP)
502 FORMAT(1P12E10.3)
IF(JCMA-2) 771,771,770
770 IF(JCMA-4) 2510,744,753
771 CONTINUE
XP1=X(1)
VF=VFZ
ITL=10
ITS=1
VRP=(TH-TPR(1))/(TPR(2)-TPR(1))
TNXT=AMAX1(TPR(2),TPR(1))
CH = TCH(1)+VRP*(TCH(2)-TCH(1))
GRA=TRAD(1)+VRP*(TRAD(2)-TRAD(1))
CHZ=CH
IPR=1
ERFX=D(1)
CALL LOOK(12,66M6/CH,THS,0,0,0,0,Y2,D2,0)
IMS=IR(12)
VRM=VR
2510 ILO(14)=NLO(IMS)
IHI(14)=NHI(IMS)
ILO(15)=NLO(IMS+1)
IHI(15)=NHI(IMS+1)
I1=ILO(14)
I2=ILO(15)
L1=I1
L2=I2
ERRM=1.0
IF(IHI(14)-ILO(14)) 420,420,729
729 CONTINUE
IF(TCHEM(I2,IMS+1,1)-VOID) 730,731,730
730 IF(TCHEM(I1,IMS,1)-VOID) 732,731,732
732 IF(TCHEM(I2,IMS+1,2)-VOID/ 733,731,733

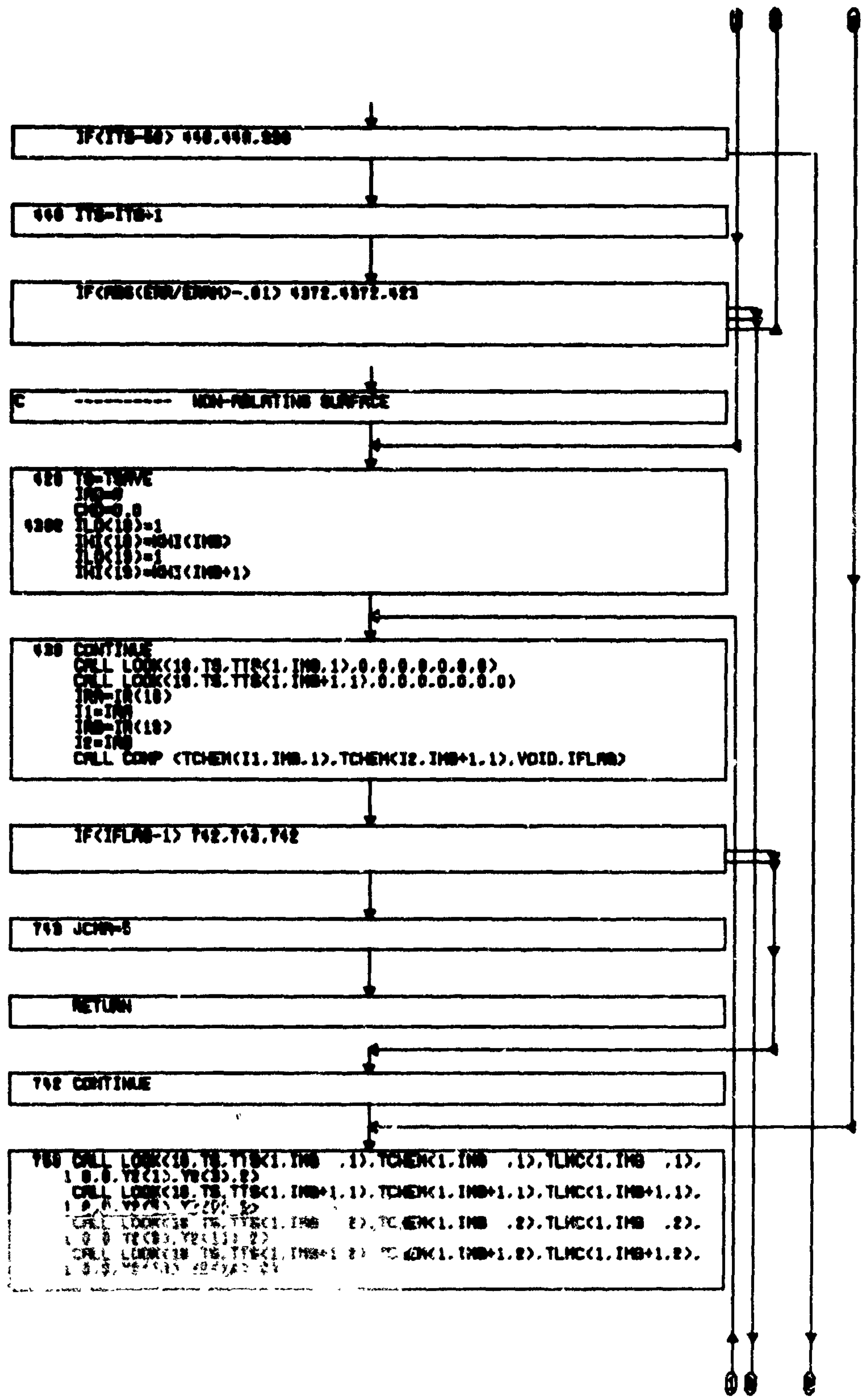
```
730 IF(TCHEM(I1.IMB.2)-VOID) 2510.731.2510

731 JCHM=3

    RETURN

2510 TABC=TTS(I1.IMB.1)+VNM*(TTS(I2.IMB+1.1)-TTS(I1.IMB.1))
2515 TABC=TABC+(VMP*(TTS(I1.IMB.2)+VNM*(TTS(I2.IMB+1.2)-TTS(I1.IMB+1.2))
    1-TABC)

2503 IF(TGAVE-TABC+.0001) 420.420.421

C      ----------  ABLATING SURFACE

421 IF(IMB) 422.422.423

422 CHOL=TLMC(I1.IMB.1)-VNM*(TLMC(I1.IMB.1)-TLMC(I2.IMB+1.1))
    CHO=EXP(CHOL)*CH
    IMB=1

423 CALL LOOK(14.CHOL.TLMC(1.IMB.1).0.0.0.0.0.0.0)
    IMA=IR(14)
    I1=IMA
    CALL LOOK(15.CHOL.TLMC(1.IMB+1.1).0.0.0.0.0.0.0)
    IMB=IR(15)
    I2=IMB
    CALL COMP (TCHEM(I1.IMB.1).TCHEM(I2.IMB+1.1).VOID.IFLAG)

    IF(IFLAG-1) 740.741.740

741 JCHM=4

    RETURN

740 CONTINUE
```

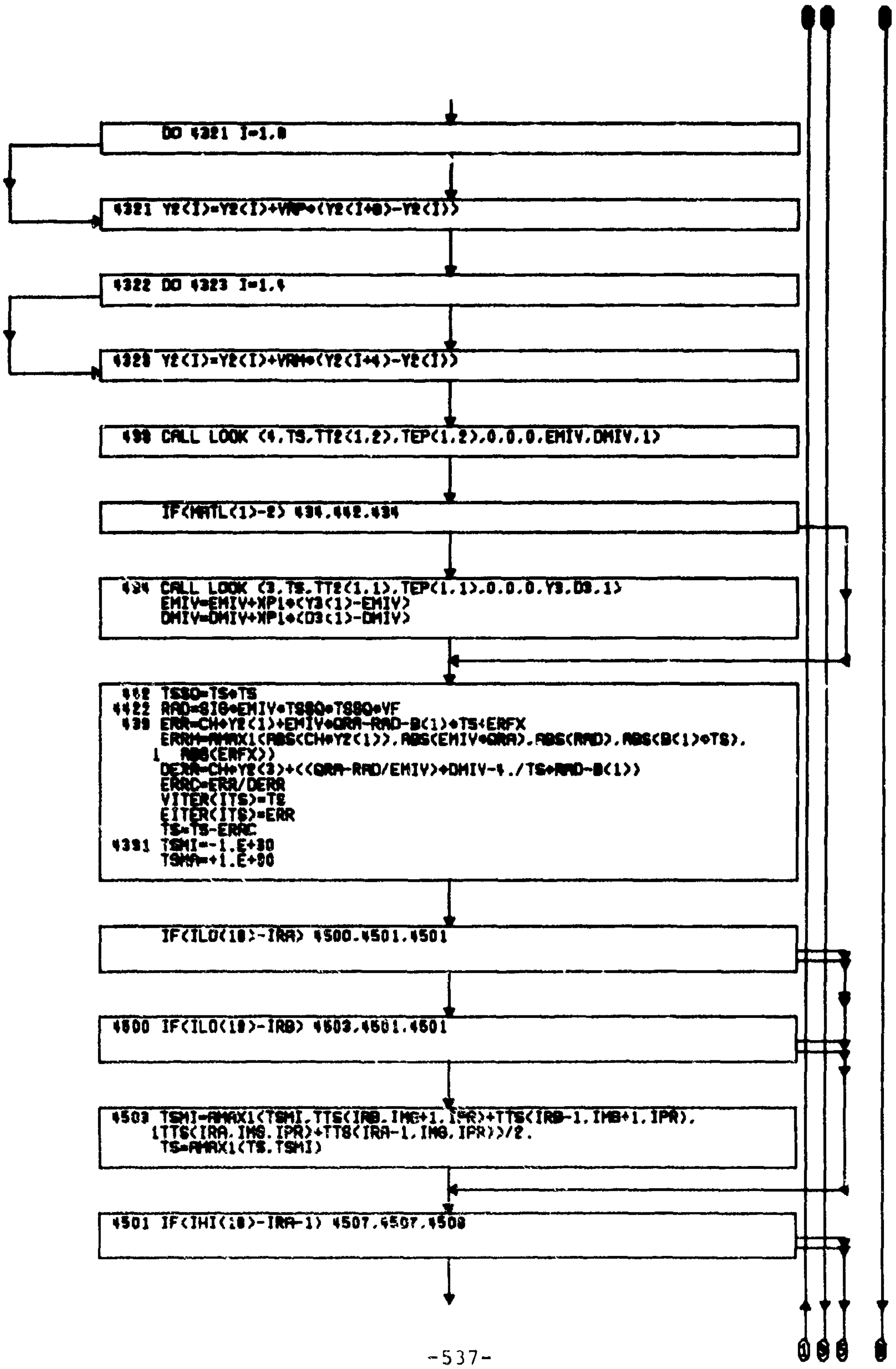


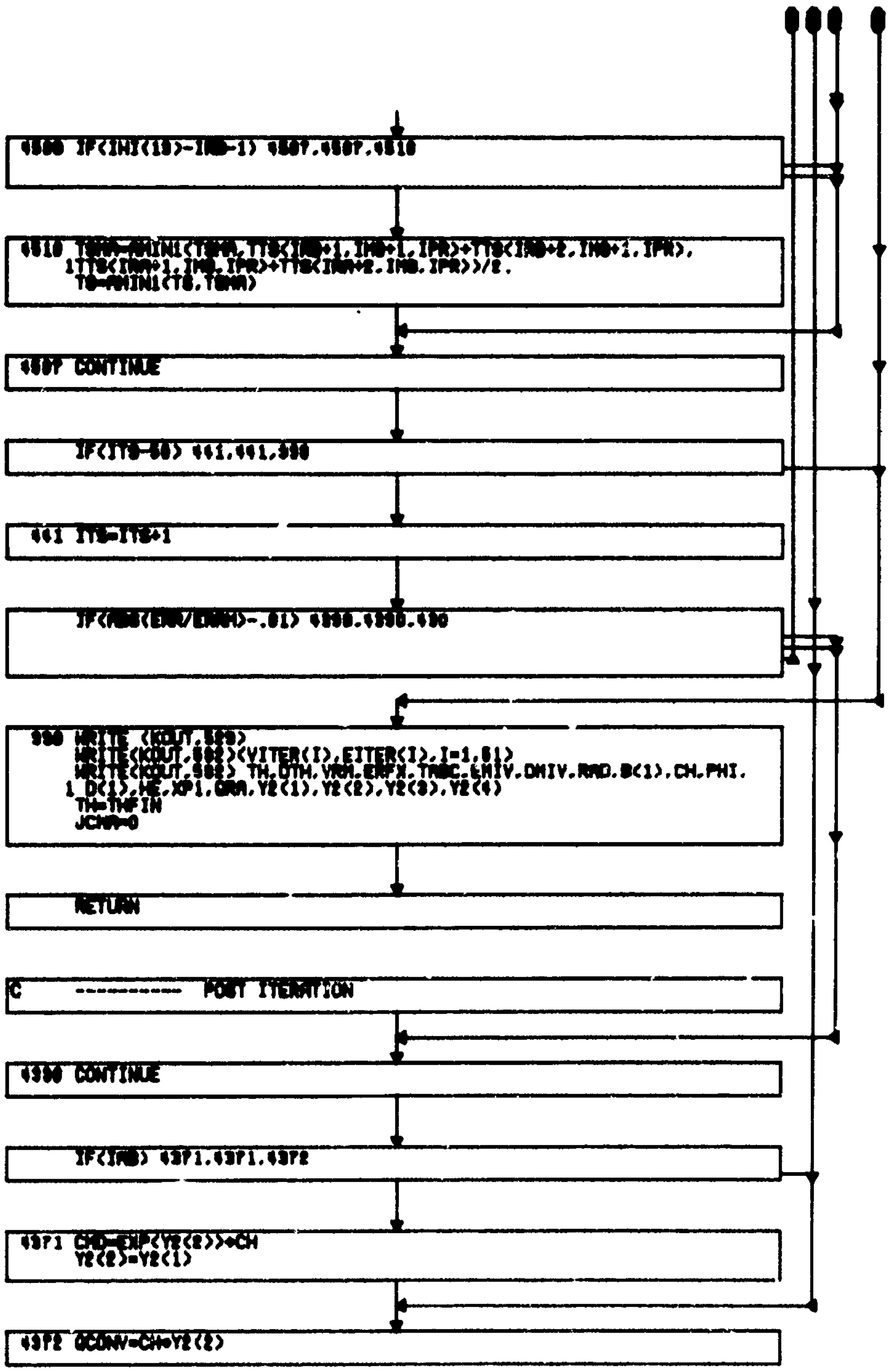
744 CALL LOOK(14,CMOL,TLMC(1,IM8,1),TTS(1,IM8,1),TCHEM(1,IM8,1),0.0,
1Y2(1),Y2(3),2)
CALL LOOK(15,CMOL,TLMC(1,IM8+1,1),TTS(1,IM8+1,1),TCHEM(1,IM8+1,1),
10.0,Y2(5),Y2(7),2)
CALL LOOK(14,CMOL,TLMC(1,IM8,2),TTS(1,IM8,2),TCHEM(1,IM8,2),0.0,
1Y2(9),Y2(11),2)
CALL LOOK(15,CMOL,TLMC(1,IM8+1,2),TTS(1,IM8+1,2),TCHEM(1,IM8+1,2),
10.0,Y2(13),Y2(15),2)
IIX=IEX-2
DO 4282 I=1,8
4282 Y2(I)=Y2(I)+VRP*(Y2(I+8)-Y2(I))
4283 DO 426 I=1,4
426 Y2(I)=Y2(I)+ (Y2(I+4)-Y2(I))*VRM
IF(Y2(1)) 4260,4260,4261
4260 ITL=ITS
GO TO 4366
4261 CONTINUE
CALL LOOK(4,Y2(1),TT2(1,2),TEP(1,2),0.0,0.EMIV,DMIV,1)
IF(MATL(1)-2) 428,427,428
428 CALL LOOK(8,Y2(1),TT2(1,1),TEP(1,1),0.0,0.0,Y3,D3,1)
EMIV=EMIV+XP1*(Y3(1)-EMIV)
DMIV=DMIV+XP1*(D3(1)-DMIV)
427 TSSQ=Y2(1)*Y2(1)
TS=Y2(1)
RAD=SIG*EMIV*TSSQ*TSSQ*VF
438 ERR=CH*Y2(2)+EMIV*QRA-RAD-B(1)*TS+ERFX
EPRM=AMAX1(ABS(CH*Y2(2)),ABS(EMIV*QRA),ABS(RAD),ABS(B(1)*TS),
1 ABS(ERFX))
DERR=CH*Y2(4)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))*Y2(3)


ITL=ITS
CONTINUE
IF(ILO(14)-IRA) 4361,4363,4363
IF(ILO(15)-IRB) 4270,4363,4363
CMDL=AMAX1(CMDL,CMMI)
IF(IHI(14)-IRA-1) 4360,4360,4364
IF(IHI(15)-IRB-1) 4365,4365,4275
IF(ITS-ITL)
IF(ERRS) 420,4367,4367


4275 CHMA=AMIN1(CHMA,TLMC(IMA+1,IMB,IPR)+TLMC(IMA+2,IMB,IPR),TLMC(IMB+1
1,IMB+1,IPR)+TLMC(IMB+2,IMB+1,IPR))/2.
CMDL=AMIN1(CMDL,CHMA)
IF(ITS-ITL-1) 4366,4351,4352
4351 ERRS=ERR
CMDL=CHMA
GO TO 4278
4352 IF(ERR+ERRS) 4354,4367,4353
4353 CMDL=CHMA
GO TO 4278
4354 ITL=65
IF(ERRC) 4355,4367,4367
4355 CMDL=CHMI
GO TO 4278
4366 IF(ITS-ITL) 4367,4356,4367
4356 CMDL=AMIN1(TLMC(L1,IMB,IPR),TLMC(L2,IMB+1,IPR))
4279 CMDL=AMIN1(CMDL,TLMC(L1,IMB,IPR+1),TLMC(L2,IMB+1,IPR+1))
4278 ERR=1.E+20


IF(ITS-50) 440.440.880
440 ITS=ITS+1
IF(ABS(ERR/ERRH)-.01) 4372.4372.423
C ---------- NON-ABLATING SURFACE
420 TS=TWAVE
IMB=0
CMB=0.0
4200 ILO(10)=1
IHI(10)=NHI(IMB)
ILO(19)=1
IHI(19)=NHI(IMB+1)
430 CONTINUE
CALL LOOK(10.TS.TTS(1.IMB.1).0.0.0.0.0.0.0)
CALL LOOK(19.TS.TTS(1.IMB+1.1).0.0.0.0.0.0.0)
IMM=IR(10)
I1=IMM
IMB=IR(19)
I2=IMB
CALL COMP (TCHEM(I1.IMB.1).TCHEM(I2.IMB+1.1).VOID.IFLAG)
IF(IFLAG-1) 742.743.742
743 JCMA=5
RETURN
742 CONTINUE
750 CALL LOOK(10.TS.TTS(1.IMB .1).TCHEM(1.IMB .1).TLHC(1.IMB .1).
1 0.0.Y2(1).Y2(3).2)
CALL LOOK(10.TS.TTS(1.IMB+1.1).TCHEM(1.IMB+1.1).TLHC(1.IMB+1.1).
TLHC(1.IMB .2).
TLHC(1.IMB+1.2).


DO 4321 I=1,8
4321 Y2(I)=Y2(I)+VRP*(Y2(I+8)-Y2(I))
4322 DO 4323 I=1,4
4323 Y2(I)=Y2(I)+VRM*(Y2(I+4)-Y2(I))
438 CALL LOOK (4,TS,TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)
IF(MATL(1)-2) 434,442,434
434 CALL LOOK (3,TS,TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)
EMIV=EMIV+XP1*(Y3(1)-EMIV)
DMIV=DMIV+XP1*(D3(1)-DMIV)
442 TSSQ=TS*TS
4422 RAD=SIG*EMIV*TSSQ*TSSQ*VF
439 ERR=CH*Y2(1)+EMIV*QRA-RAD-B(1)*TS+ERFX
ERRM=AMAX1(ABS(CH*Y2(1)),ABS(EMIV*QRA),ABS(RAD),ABS(B(1)*TS),
1 ABS(ERFX))
DERR=CH*Y2(3)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))
ERRC=ERR/DERR
VITER(ITS)=TS
EITER(ITS)=ERR
TS=TS-ERRC
4391 TSMI=-1.E+30
TSMA=+1.E+30
IF(ILO(18)-IRA) 4500,4501,4501
4500 IF(ILO(18)-IRB) 4503,4501,4501
4503 TSMI=AMAX1(TSMI,TTS(IRB,IMG+1,IPR)+TTS(IRB-1,IMB+1,IPR),
1TTS(IRA,IMG,IPR)+TTS(IRA-1,IMG,IPR))/2.
TS=AMAX1(TS,TSMI)
4501 IF(IHI(18)-IRA-1) 4507,4507,4508


IF(IHI(13)-IMB-1) 4507,4507,4510
4510 TEMA=AMIN1(TEMA,TTS(IMB+1,IMB+1,IPR)+TTS(IMB+2,IMB+1,IPR),
1TTS(IMA+1,IMB,IPR)+TTS(IMA+2,IMB,IPR))/2.
TS=AMIN1(TS,TEMA)
4507 CONTINUE
IF(ITS-50) 441,441,990
441 ITS=ITS+1
IF(ABS(ENR/ENRM)-.01) 4390,4390,430
990 WRITE (KOUT,505)
WRITE(KOUT,502)(VITER(I),EITER(I),I=1,51)
WRITE(KOUT,503) TH,DTH,VRM,ERFX,TRBC,EMIV,DMIV,RAD,B(1),CH,PHI,
1 D(1),HE,XP1,QRA,Y2(1),Y2(2),Y2(3),Y2(4)
TH=THFIN
JCHR=0
RETURN
C ---------- POST ITERATION
4390 CONTINUE
IF(IMB) 4371,4371,4372
4371 CHD=EXP(Y2(2))*CH
Y2(2)=Y2(1)
4372 QCONV=CH*Y2(2)

```
      IF(KCH(4)) 4376,4375,4376
```

```
4376  WRITE(KOUT,502) (VITER(I),EITER(I),I=1,ITS)
      WRITE(KOUT,502) TH,DTH,VRM,ERFX,TABC,EMIV,DMIV,RAD,B(1),CH,PHI,
     1 D(1),HE,XP1,QRA,Y2,DERR,VRP
```

```
4375  CONTINUE
      QCHEM=0.
      DEDTB=CMD/RHO(2)
1497  RO(1)=RON(1)
      RR=CH/CHZ
      QRP=EMIV*QRA
      QCOND=-D(1)+B(1)*TA(1)
      QCONVT=QCONVT+QCONV*DTH/AREA(1)*ASU
      QCHEMT=QCHEMT+QCHEM*DTH/AREA(1)*ASU
      QCONDT=QCONDT+QCOND*DTH/AREA(1)*ASU
      QRPT=QRPT+QRP*DTH/AREA(1)*ASU
      RADT=RADT+RAD*DTH/AREA(1)*ASU
C
      DEDT=RON(1)*CP(1)*(TS-TSAVE)*DEL(1)/DTH
```

```
      DO 95 I=2,NL
```

```
      RO(I) = RON(I)
      TEMP =(D(I   )-A(I   )*TA(I-1))/B(I   )
      DEDT=DEDT+RON(I)*CP(I)*(TEMP-TA(I))*DEL(I)*RR(I)/DTH
```

```
   95 TA(I)=TEMP
```

```
      IF (NUMN-NBM) 97,96,96
```

```
   96 K=NL
      TA(NBM-1) = TA(NL)
```

```
      DO 98 I = NBM,NUMN
```

```
      K = K+1
```

```
   98 TA(I) = (D(K)-A(K)*TA(I-1))/B(K)
```

```
   97 DEDTT=DEDTT+DEDT*DTH/AREA(1)*ASU
      JCMA=1
```

RETURN

END

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13. ABSTRACT

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Listings and flow charts for the Boundary Layer Integral Matrix Procedure (BLIMP) computer program are given, along with comments on the function of each program or subroutine. In addition, input instructions, output description, a sample problem, flow charts and listings are given for the CABLE program, which couples BLIMP to an in-depth charring ablation analysis program.

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Viscous flow						
Plasma sheath						
Missile reentry						
Computer program						
Nonsimilar boundary layer						